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Empire Building, Pittsburgh, Pennsylvania

IRON AND STEEL ENGINEER

JANUARY • 1940

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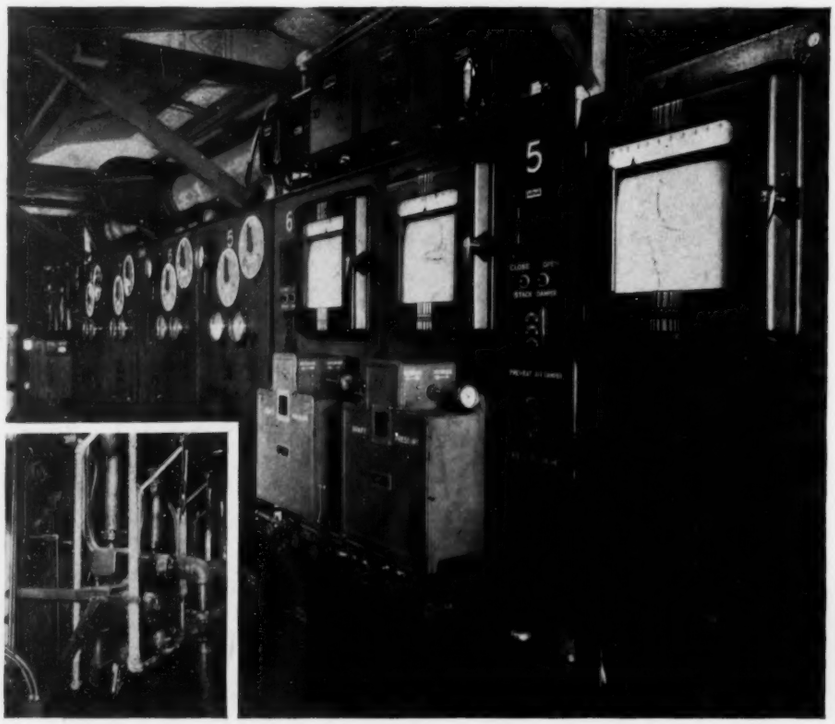
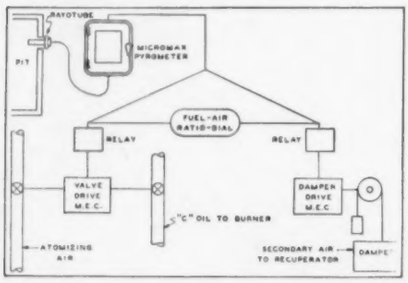


MICRO-RESPONSIVE CONTROL IS APPLIED TO BOTH HEAT AND COMBUSTION IN FURNACE

The path toward an outstanding job of furnace control is pointed by work recently done at Roebling, N. J., in the plant of John A. Roebling's Sons. The furnaces regulated are soaking pits, but the principles apply to other types of furnace.

This Control not only brings the micro-responsiveness of the Micromax Pyrometer to bear on temperature control, but it also ties in the control of combustion. As a result, ingots are heated with great uniformity; heated to a thoroughly plastic condition; and heated in an oxidizing atmosphere, so that scale is hard, and breaks off cleanly in the rolling mills. These results are accomplished with very economical equipment and at low fuel cost.



Schematic Diagram of Micromax Control Applied to Soaking Pit

As shown in the diagram, pit temperature is detected by a Rayotube, measured and recorded by a Micromax pyrometer, and controlled by a Micromax Electric Control valve-drive which moves both fuel and atomizing-air (primary air) valves. Also controlled by the Micromax is a drive to the recuperator's intake damper, through which secondary air enters. The action of valves and damper can be re-proportioned by setting a fuel-air ratio dial.

Thus the valves for primary and secondary air, and for fuel, are changed with each change in furnace load. They "edge" up and down; never moving suddenly, but handled as the heater would handle them if he had nothing else to do.

Changes in furnace load do not affect furnace pressure; an L&N instrument, entirely separate from the temperature-fuel-air system, automatically holds pressure at any desired point by moving the stack damper.

This type of control is especially recommended where air infiltration is a large variable; it gives quite satisfactory combustion, and temperature control which is extremely close. Instruments are standard. Details on request.

Refrigerator Maker Avoids "Bottleneck" In Parts Tempering

Tempering — normalizing — annealing — call the various strain-relieving operations what you will, they cannot "bottleneck" the electric-refrigerator heat-treat shown below. On one side of the tempering division are mountains of parts to be tempered; on the other side the assembly is waiting for them. It is very simple to temper as many parts, or as few, as are required.

For, quick to heat and quick to cool, the Homo Furnaces lose no time in handling loads at all temperatures in the tempering range. They heat with such uniformity that rejects due to tempering are all but unknown. They're fully automatic — require only loading and unloading. They're clean — the heat-treaters like to use them. They can, if necessary, run 3 shifts a day for months on end.

Mass-production tempering of refrigerator parts is done in this battery of 4 Homo Furnaces, set in pits.

Have you a tempering problem? There are Homo types and sizes for any need described in Catalog T-625.

New Bulletin On Speedomax Recorder

Both roll operator and instrument man will find many advantages in the 1940 model Speedomax high-speed recorder.

It is much faster than the earlier model—between ten and fifteen times as fast as the standard potentiometer pyrometer — so that its record tells more about the temperature of the rod, angle, plate, etc., being rolled. And this Speedomax is far simpler mechanically.

For information, see new, 12-page illustrated bulletin N-33B-685(1); sent on request.

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BUILT BY MORGAN *Engineering*

MORGAN
35″ BLOOMING MILL

● Above is shown a Morgan 35″ two-high blooming mill complete with double manipulator, front and rear tables. Two mills of this type were recently furnished prominent mid-west steel producers. Housings are one-piece steel castings of the closed top type. Top roll balance is of the counterweight type. Manipulator is of the overhead type, compact and accessible. Tables are of heavy design, equipped with anti-friction bearings. Screw-down drive is arranged to provide crane hook access when changing guides. Provision is made for automatic lubrication and exclusion of scale and dirt.

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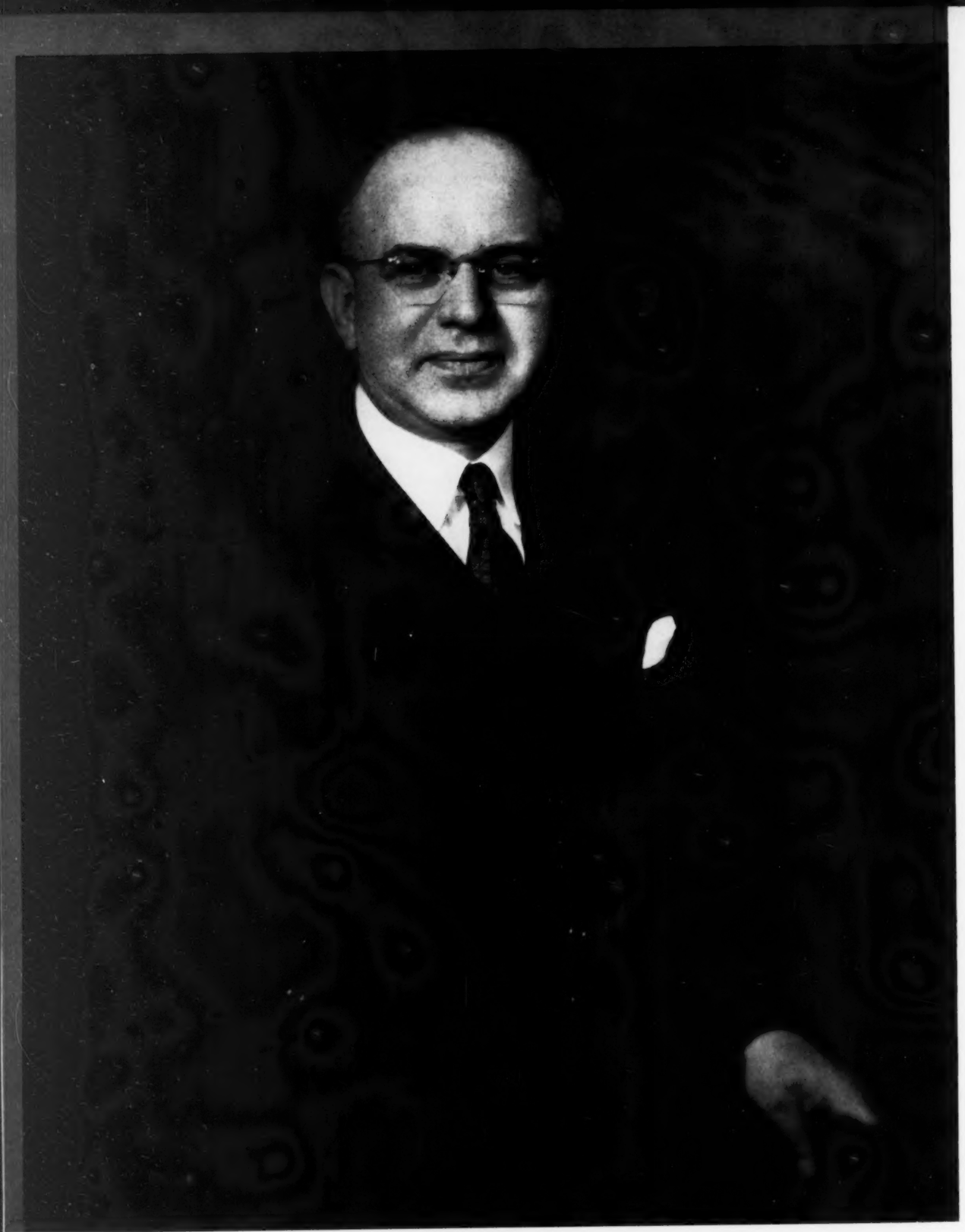


J. A. CLAUSS

PRESIDENT, ASSOCIATION OF IRON AND STEEL ENGINEERS

The Association of Iron and Steel Engineers is planning for the coming year a program which should be of great benefit to the members and the industry which they serve. The primary object for the existence of the Association is the advancement of the technical and engineering phases of the manufacture of iron and steel, and the rolling and forming of steel, through the cooperation of its members.

We are encouraged in proposing a program covering the study of a wide variety of subjects which are important to the industry by the generous support which our efforts in the past have received from the vast majority of the leading executives of the iron and steel industry. The alert management of the iron and steel industry recognizes that progress and improvement are the result of continual study and investigation of the present methods and equipment in an effort to make that which is good today better for tomorrow. Only by a constant review of what has been accomplished and a free discussion of new ideas can real progress be made.

In this modern age, in which our common welfare and prosperity are so intimately linked together, it has become a vital necessity that men engaged in the same industry form associations for the purpose of exchanging ideas and discussing problems common to that industry. It is a recognized fact that the benefits derived from improvement and economies effected by industry are first enjoyed by the general public and then only by the industry which had the foresight to put into effect the ideas developed by study and investigation.

Today the executives recognize the fact that the preparation of a technical paper to be read and discussed at one of our meetings requires that the author study carefully all of the factors involved, thus increasing and crystallizing his knowledge of the subject, and the discussion of the facts presented by others equally interested brings to light aspects of the problem never thought of before. The presentation of known facts and the discussion which follows benefit not only the active participants but our entire membership, because, through the medium of our official magazine, *Iron and Steel Engineer,* the paper and discussion are available to every member and become a permanent record for future reference. It is evident that the members of our Association and the industry in which we are engaged benefit from the increased knowledge of the subject resulting from such procedure.

The members of our Association are vitally interested in the progress and prosperity of the iron and steel industry; they devote a large part of their own time in the preparation of papers and discussions; and it is this unselfish loyalty to a great industry that has made ours the outstanding engineering society today. The progress which has been made and the good that has been accomplished should encourage us to still greater efforts.

Practically every branch of engineering is employed in the iron and steel industry. Our Association, so closely identified with the industry, provides a common ground and forum where all the various technicians and operators can meet, form contacts with others in similar positions, and exchange ideas, thus enlarging their usefulness and benefiting themselves and the companies which they serve.

At our Spring Conference in Cincinnati next April, at our Annual Convention and Iron and Steel Exposition in Chicago next September, and also at the various meetings of the District Sections, interesting papers covering important phases of our industry will be presented and discussed. These meetings should receive the active support and cooperation of the members and the encouragement of the industry's management.

The changes which are taking place today are rapid and far-reaching in their effect on the established order. The struggle to keep the wheels of industry turning in the midst of all the unrest and turmoil of the present day taxes the strength and ingenuity of able men. In spite of the handicaps with which we are confronted, we must steadily move forward. The welfare of our country and the common good demand that we must meet these changing conditions.

At the Exposition, the latest developments in equipment used by the industry are displayed and their merits and uses explained and demonstrated by experts from the builders of the equipment. The Iron and Steel Exposition, which is always part of our annual meeting, is an important part of our activities because here you can see working models and full-size equipment of the new developments you may have heard about. Time spent at the Exposition is well worth while. You will be amazed to see the many new devices for improving the operation of rolling mill equipment that are brought forth each year by the builders and suppliers who serve the iron and steel industry.

Active participation in the activities of this Association gives to our members the opportunity to do their part in furthering the progress of the iron and steel industry. Our Association is not only interested in the material things connected with our industry—we recognize that the best machine we can design is only so much iron and steel without a human operator. We are interested in the welfare of the young men entering the industry, and to further their advancement each one of our six District Sections is carrying on an educational program consisting of either lectures, research, night-schools, or scholarships in recognized engineering schools.

We are keenly interested in promoting the interests of the younger group of our membership, and strongly urge them to take an active part in the Association's activities. We realize that with the passing years the young members of today must carry the burden of the Association's activities and of the industry's progress.

Our Association is in splendid condition and there is a healthy growth in membership. Your newly elected officers and directors need your wholehearted and continued cooperation so that the ideals we are striving for can be reached and the prestige and influence of our Association increased.

J. A. CLAUSS

F. P. MAY
DIRECTOR

THOMAS E. HUGHES
SECOND VICE-PRESIDENT

L. R. MILBURN
DIRECTOR

GEORGE E. ADAMS
DIRECTOR

NEWLY ELECTED OFFICERS AND DIRECTORS

JULIUS A. CLAUSS started his steel mill career with the Lackawanna Steel Company, which company he was with for seven years. He then went with Corrigan-McKinney Steel Company for two and one-half years as chief designer and checker. Following this he was the chief draftsman for the William Tod Company at Youngstown, Ohio. Leaving this company he went with the Republic Iron and Steel Company as assistant chief draftsman for twelve years. The next three and one-half years he served as chief engineer for the Trumbull Steel Company, and from March 1929 he has been with the Great Lakes Steel Corporation, at Ecorse, Michigan, as chief engineer.

WILLIAM A. PERRY started with the Inland Steel Company in 1910, and successively held the positions of mill motor foreman, assistant superintendent of power stations, and assistant electrical superintendent. He was advanced to his present position as superintendent of the electrical and power departments with the company in January 1931.

THOMAS E. HUGHES, superintendent of maintenance department, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania, has spent his entire business background in the steel industry. Mr. Hughes started to work with the Union Railroad in 1902, and successively worked at the Clairton Plant of the Carnegie-Illinois Steel Corporation, McKeesport Plant of the National Tube Company, Youngstown Plant of the Youngstown Sheet and Tube Company, and for the past twenty-seven years has been at the Duquesne Plant of the Carnegie-Illinois Steel Corporation. Mr. Hughes attended the public schools of Duquesne, and the night classes of the Carnegie Institute of Technology.

C. L. McGRANAHAN'S first work in the steel industry was in 1916 with American Sheet and Tin Plate Company. He worked in various positions with the company at their different plants until 1931, allowing for one year World War service. In 1931 he joined the Inland Steel Company as superintendent of the company's Indiana Harbor hot strip mill, resigning in February 1936, to take his present position as assistant general superintendent with the Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania. Mr. McGranahan was graduated from Pennsylvania State College in 1916 with a bachelor of science degree in civil engineering.

FRANK EDWARD FLYNN started in the steel business with the Superior Steel Company at Carnegie, progressing from the position of water boy to that of boss roller. In 1916, he started in charge of rolling at the Phillips Sheet and Tin Plate Company, which later became the Weirton Steel Company, and during his 11 years service there he became assistant manager and then manager. He went to the Trumbull Steel Company in 1928, as assistant vice president in charge of operations. This company later became a unit of Republic Steel Corporation, and he became district manager, with headquarters at Warren, Ohio.

J. LEDLIE MILLER has been employed in the steel industry since 1909, serving as messenger, draftsman, and in the experimental engineering department of Carnegie Steel until he joined the army, where he served overseas as lieutenant in the heavy field artillery. Serving as fuel engineer at the Bellaire works of Carnegie from March 1919 until that fall, he returned to the Carnegie Institute of Technology where he received his degree in mechanical engineering the following year.

Mr. Miller returned to Bellaire as fuel engineer and when this plant was closed, went to the Follansbee Brothers plant in Toronto, where he was annealing department foreman and assistant metallurgist until January 1, 1925. He served as fuel engineer of the Wheeling Steel Corporation in the Wheeling district from 1925 until he went to Youngstown for Carnegie in 1928. He acted as assistant chief engineer of Carnegie-Illinois Steel Corporation in the Youngstown district from 1928 to 1936. In 1937 he was appointed assistant chief combustion engineer of Republic Steel Corporation with headquarters in Cleveland.

F. E. FLYNN
TREASURER

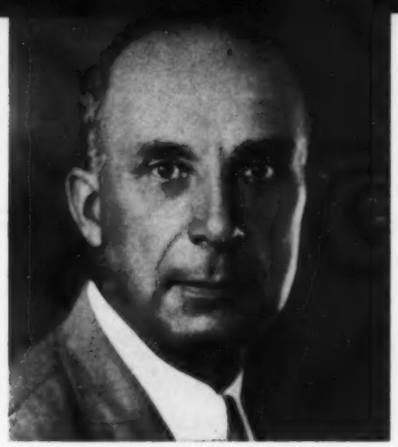
J. L. MILLER
SECRETARY

C. L. McGRANAHAN
DIRECTOR-AT-LARGE

W. A. PERRY
FIRST VICE-PRESIDENT

F. L. GRAY

DIRECTOR



F. W. LORIG

DIRECTOR

F. M. STURGESS

DIRECTOR

L. V. BLACK

DIRECTOR

FRANK P. MAY, assistant chief engineer, by-product coke works Carnegie-Illinois Steel Corporation, Clairton, Pennsylvania, was graduated from the School of Electrical Engineering at Purdue University in 1913. Mr. May took his first position following graduation at the Mingo Works of the former Carnegie Steel Company, holding the title of assistant to the chief engineer. In 1916 he was advanced to assistant superintendent of the electrical department, and in 1927 became assistant superintendent of maintenance. In 1933 he was named assistant superintendent of maintenance in charge of the electrical department. He was transferred in 1937 to the Clairton Works of the Carnegie-Illinois Steel Corporation, taking the position he holds at the present time.

GEORGE E. ADAMS, electrical superintendent, Youngstown Sheet and Tube Company, East Chicago, Indiana, was graduated from the University of Purdue's School of Electrical Engineering in 1914. Mr. Adams worked in the electrical department of the former Illinois Steel Company, Gary Works, from 1914 to 1928. During this period he worked at various maintenance jobs, electrical testing engineer, and was assistant electrical engineer at the time he left to go to Youngstown Sheet and Tube Company. Starting as assistant district engineer, Mr. Adams was appointed electrical superintendent in 1935, the position he holds at this time.

L. V. BLACK, superintendent of electrical department, Bethlehem Steel Company, Bethlehem, Pennsylvania, was graduated from Pennsylvania State College in 1914. Starting to work immediately, Mr. Black worked his way through successive steps to the post of assistant superintendent of the electrical department of the Bethlehem Plant. In August 1938, he succeeded the late A. J. Standing as electrical superintendent.

L. R. MILBURN, electrical engineer, Great Lakes Steel Corporation, Ecorse, Michigan, was graduated from the University of Michigan with a degree of electrical engineering in June 1918. From July 1918 until December 1918, Mr. Milburn was in the United States Army. In January 1919 he went with the General Electric Company doing testing, complaint, installation, and apparatus sales work. In March 1925, he moved to the Louisville Gas and Electric Company where he did construction work until October 1929, obtaining excellent knowledge of the working of a central station industry. Starting his steel mill career in October 1929 with the Great Lakes Steel Corporation as electrical draftsman, Mr. Milburn remained in this position until 1933 when he was appointed acting electrical engineer. In 1935 he was promoted to electrical engineer.

FRED M. STURGESS, master mechanic and chief electrician, Tennessee Coal, Iron and Railroad Company, Fairfield, Alabama, was educated at Armour Institute of Technology. Mr. Sturgess completed the Westinghouse Engineering Apprenticeship Course in 1910. His vacation periods were spent working at the former Illinois Steel Company and the former Lackawanna Steel Company. His experience included work in rod mills, chemical laboratory and electrical maintenance department. Mr. Sturgess started as electrical foreman with the American Steel and Wire Company at their Fairfield Wire Works in January 1911, from which position he advanced to the one he now holds with the Tennessee Coal, Iron and Railroad Company.

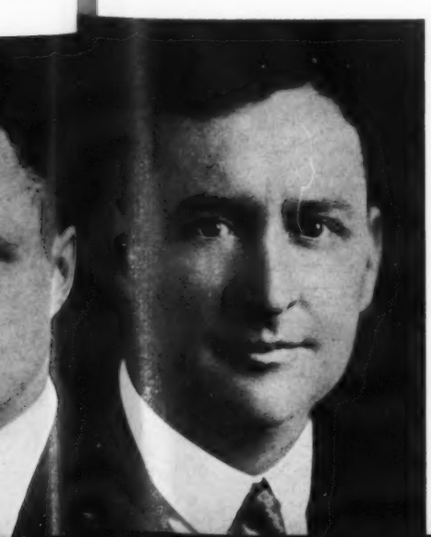
FRANK W. LORIG started to work as tracer and draftsman in 1904 at the Bucyrus Company, South Milwaukee, Wisconsin. After graduating in 1913 from the University of Wisconsin, receiving a B.S. degree in mechanical engineering, Mr. Lorig went to work with the West Penn Traction Company, Pittsburgh, Pennsylvania, as a draftsman.

He started his steel mill career with the American Steel and Wire Company, Cleveland, Ohio, in 1915, as a draftsman. By 1918 he had worked his way to the post of chief draftsman in the construction engineer's office, going from there in 1936 to the post of assistant construction engineer. In 1937 he became construction engineer, and in 1939 he was appointed engineer for appropriations and properties.

MARTIN J. CONWAY was educated in mechanical and chemical engineering at Hanley and Oxford Universities, England. From 1920 to 1923 he was fuel engineer for Pittsburgh Crucible Steel Company, Midland, Pennsylvania, and held a similar position at the Steubenville, Ohio, plant of the Wheeling Steel Corporation from 1923 to 1926. For the past thirteen years he has been associated with the Lukens Steel Company, Coatesville, Pennsylvania, as fuel engineer.

A. W. STEED was graduated from the University of Missouri with a bachelor of science degree in mechanical engineering in 1910. Mr. Steed started in the same year, 1910, with the Westinghouse Machine Company. In 1915 he joined the American Rolling Mill Company at Middletown, Ohio, where he was employed in the power department. He was made power superintendent of this plant in 1923, and in 1929 he became superintendent of maintenance, holding this position until the present time.

FRANK L. GRAY, lubrication engineer, Carnegie-Illinois Steel Corporation, Gary Works, started with this company in 1919, upon the completion of his service in the army during the World War. After six years in various mill capacities, he was assigned, in 1925, to the lubrication field and has since continued as lubrication engineer of the Gary plant.



M. J. CONWAY

DIRECTOR

A. W. STEED

DIRECTOR

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1921 E. S. JEFFERIES, *General Manager*, Universal Boring Machine Company, Hudson, Massachusetts.

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1924 *Chairman:* R. S. SHOEMAKER, *Lubrication Engineer*, American Rolling Mill Company, Middletown, Ohio.

1925 A. C. CUMMINS, *Assistant Manager of Operations*, Pittsburgh District, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

1926 G. H. SCHAEFFER, *Electrical Engineer*, Carpenter Steel Company, Reading, Pennsylvania.

1927 S. S. WALES (Retired), Box B., Westside Station, Youngstown, Ohio.

1930 F. W. CRAMER, *Electrical Engineer*, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

1931 F. O. SCHNURE, *Electrical Superintendent*, Bethlehem Steel Company, Sparrows Point, Maryland.

1932 J. J. BOOTH, *Assistant Superintendent of Maintenance*, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.

1933 J. D. DONOVAN, *Electrical and Mechanical Superintendent*, Republic Steel Corporation, Massillon, Ohio.

1935 W. H. BURR, *Electrical Superintendent*, Lukens Steel Company, Coatesville, Pennsylvania.

1936 G. R. CARROLL, *Assistant Superintendent of Maintenance*, Jones and Laughlin Steel Corporation, Aliquippa, Pennsylvania.

1937 H. G. R. BENNETT, *Assistant General Superintendent*, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.

1938 L. F. COFFIN, *Superintendent*, Mechanical Department, Bethlehem Steel Company, Sparrows Point, Maryland.

1939 C. CLARKE WALES, *General Manager*, Hamilton Bridge Company, Hamilton, Ontario, Canada.

MEMBERSHIP COMMITTEE

Chairman: THOMAS E. HUGHES, *Superintendent of Maintenance*, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.

FREEMAN H. DYKE, *Superintendent*, Blooming, Bar and Hot Strip Mills, Wheeling Steel Corporation, Steubenville, Ohio.

HAROLD P. INGRAM, *Superintendent of Maintenance*, Carnegie-Illinois Steel Corporation, Homestead, Pennsylvania.

HOWARD F. MARTIN, *Superintendent of Maintenance*, Jones and Laughlin Steel Corporation, Aliquippa, Pennsylvania.

I. N. TULL, *Electrical Superintendent*, Republic Steel Corporation, Cleveland, Ohio.

W. W. SPANAGEL, *District Manager*, Reliance Electric and Engineering Company, Cleveland, Ohio.

GEORGE C. PFEFFER, *Chief Electrician*, Florence Pipe Foundry and Machine Company, Florence, New Jersey.

LINN O. MORROW, Schaff Building, Philadelphia, Pennsylvania.

A. J. WHITCOMB, *Electrical Engineer*, Freyn Engineering Company, Chicago, Illinois.

A. R. DIBBIN, *Assistant Electrical Superintendent*, Youngstown Sheet and Tube Company, East Chicago, Indiana.

ELMER F. WEISS, *District Manager*, Cutler-Hammer, Inc., Detroit, Michigan.

L. R. MILBURN, *Electrical Engineer*, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan.

BIRGER THELE, *Electrical Engineer*, Coal Mines, Tennessee Coal, Iron and Railroad Company, Pratt City Station, Birmingham, Alabama.

W. H. BEATTY, *District Manager*, Electric Controller and Manufacturing Company, Birmingham, Alabama.

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JAMES FARRINGTON, *Electrical Superintendent*, Wheeling Steel Corporation, Steubenville, Ohio.

W. A. PERRY, *Superintendent*, Electrical and Power Departments, Inland Steel Company, East Chicago, Indiana.

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Chairman: F. D. EGAN, *Electrical Superintendent*, Bethlehem Steel Company, Lackawanna, New York.

Following committees to be appointed when and as required:

Mechanical Division — Lubrication Division
Electrical Division — Welding Division
Combustion Division — Operating Practice Division
General Division

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F. O. SCHNURE, *Chairman*, Electrical Engineering Division.

G. H. ROSE, *Chairman*, Mechanical Engineering Division.

M. J. CONWAY, *Chairman*, Combustion Engineering Division.

F. J. THOMAS, *Chairman*, Lubrication Engineering Division.

L. J. GOULD, *Chairman*, Welding Engineering Division.

H. G. R. BENNETT, *Chairman*, Operating Practice Division.

W. H. BURR, *Chairman*, Development Report Committee.

Electrical Engineering Division

Chairman: F. O. SCHNURE, *Electrical Superintendent*, Bethlehem Steel Company, Sparrows Point, Maryland.

L. R. MILBURN, *Electrical Engineer*, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan.

F. W. CRAMER, *Electrical Engineer*, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

J. S. MURRAY, *Chief Electrical Engineer*, Follansbee Brothers Company, Follansbee, West Virginia.

W. H. BURR, *Electrical Superintendent*, Lukens Steel Company, Coatesville, Pennsylvania.

J. H. GRAFT, *Electrical Superintendent*, Republic Steel Corporation, Youngstown, Ohio.

W. A. PERRY, *Superintendent*, Electrical and Power Departments, Inland Steel Company, East Chicago, Indiana.

Mechanical Engineering Division

Chairman: GEORGE H. ROSE, *Chief Engineer,* American Steel and Wire Company, Cleveland, Ohio.
H. W. NEBLETT, *Development and New Design Engineer,* Inland Steel Company, East Chicago, Indiana.
F. E. KLING, *Assistant Chief Engineer,* Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.
J. D. JONES, *Chief Engineer,* Youngstown Sheet and Tube Company, Youngstown, Ohio.
K. H. McLAURIN, *General Superintendent,* Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.
L. F. COFFIN, *Mechanical Superintendent,* Bethlehem Steel Company, Sparrows Point, Maryland.

Lubrication Engineering Division

Chairman: F. J. THOMAS, *Lubrication Engineer,* Republic Steel Corporation, Cleveland, Ohio.
C. C. PECU, *Lubrication Engineer,* Bethlehem Steel Company, Lackawanna, New York.
H. R. GILCHRIST, *Lubrication Engineer,* Carnegie-Illinois Steel Corporation, Youngstown, Ohio.
C. R. HAND, *Lubricating Engineer,* Bethlehem Steel Company, Sparrows Point, Maryland.
T. R. MOXLEY, *General Master Mechanic,* Wheeling Steel Corporation, Steubenville, Ohio.

Welding Engineering Division

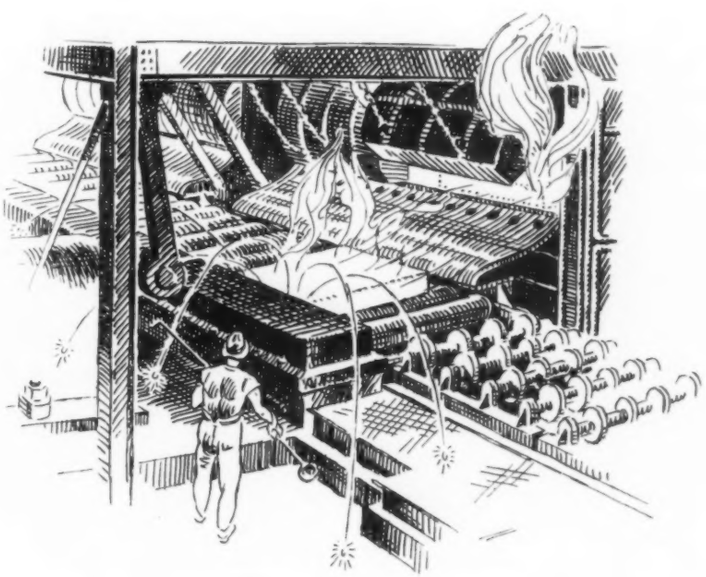
Chairman: L. J. GOULD, Assistant Chief Engineer of Construction, Bethlehem Steel Company, Bethlehem, Pennsylvania.
T. E. HUGHES, *Superintendent,* Maintenance Department, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.
A. W. STEED, *Maintenance Superintendent,* American Rolling Mill Company, Middletown, Ohio.
G. R. CARROLL, *Assistant Superintendent,* Maintenance, Jones and Laughlin Steel Corporation, Aliquippa, Pennsylvania.
H. G. HAGUE, *Assistant Superintendent,* Electrical Maintenance Department, Sheet and Tin Division, Carnegie-Illinois Steel Corporation, Gary, Indiana.

Combustion Engineering Division

Chairman: M. J. CONWAY, *Fuel Engineer,* Lukens Steel Company, Coatesville, Pennsylvania.
A. J. FISHER, *Fuel Engineer,* Bethlehem Steel Company, Sparrows Point, Maryland.
H. V. FLAGG, *Combustion Engineer,* American Rolling Mill Company, Middletown, Ohio.
F. E. LEAHY, *Fuel Engineer,* Youngstown Sheet and Tube Company, Youngstown, Ohio.
W. N. FLANAGAN, *Special Engineer,* Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.
J. L. MILLER, *Assistant Chief Combustion Engineer,* Republic Steel Corporation, Cleveland, Ohio.

Operating Practice Division

Chairman: H. G. R. BENNETT, *Assistant General Superintendent,* Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania.
C. L. McGRANAHAN, *Assistant General Superintendent,* Jones and Laughlin Steel Corporation, Pittsburgh Works, Pittsburgh, Pennsylvania.
T. J. McLOUGHLIN, *Assistant to Vice-President,* Charge of Operations, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.
J. H. NEAD, *Chief Metallurgist,* Inland Steel Company, East Chicago, Indiana.
A. H. FOSDICK, *Superintendent,* Blast Furnaces and Sintering Plant, Bethlehem Steel Company, Bethlehem, Pennsylvania.
J. G. WEST, JR., Pittsburgh, Pennsylvania.



Constitution

ASSOCIATION OF IRON AND STEEL ENGINEERS

Revised Sept. 11, 1918
Revised July 11, 1919
Revised Sept. 20, 1920
Revised Sept. 11, 1922
Revised June 23, 1936
Revised Jan. 1, 1940

ARTICLE I

SECTION 1. The name of the Association is the *Association of Iron and Steel Engineers.*

SECTION 2. The *object* of this Association shall be the advancement of the application of electricity and other branches of engineering to the iron and steel or allied industries by the cooperation of its members.

SECTION 3. Among the *means* to be employed for attaining this end shall be periodical meetings for the presentation of professional papers; the discussion of subjects pertinent to the industry; iron and steel expositions; holding conventions; inspection trips and the publication of an official magazine known as the "*Iron and Steel Engineer,*" containing papers, discussions and other matters as may seem expedient.

SECTION 4. While local sections or the National Association may hold single joint meetings with any other Engineering Society, if in their judgment it is desirable, no *permanent* alliance of any kind shall be entered into by the Association, or any of its branches, with any Engineering Association or other Society. No *temporary* alliance with any other Engineering Society shall be entered into by any local section without the approval of the Board of Directors. No motion shall be entertained by the Board of Directors under this Constitution which will actually or in effect accomplish an alliance which will in any manner or to any degree effect the purpose or fundamental principles of the Association as set forth in the Constitution.

ARTICLE II

MEMBERSHIP

SECTION 1. The *membership* of the Association shall consist of persons engaged in or identified with the application of engineering and equipment to or operations of the iron and steel or allied industries.

SECTION 2. The classes of membership shall be five in number; namely, Honorary, Life, Active, Associate and Junior.

SECTION 3. Honorary, Associate and Junior members shall be entitled to all the rights and privileges of the Association except the right to vote and hold office.

SECTION 4. *Honorary members* shall be persons who have rendered acknowledged eminent service to the Iron and Steel Industry.

SECTION 5. *Life members* shall be persons who have rendered acknowledged eminent service to the Association of Iron and Steel Engineers.

SECTION 6. *Active members* shall be persons not less than 21 years of age, actively identified with or having responsible charge of technical, engineering or supervisory work for a period of at least three years in the iron and steel or allied industries.

SECTION 7. *Associate members* shall be persons not less than 21 years of age, actively identified with a company supplying equipment, material or service to the iron and steel or allied industries and persons identified with the iron and steel or allied industries who are not qualified to become active members.

SECTION 8. *Junior members* shall be citizens of the United States or Canada and shall be persons identified with the Iron and Steel Industry and must not be less than 18 years of age, and not eligible for membership under any other classification. After the age of 27 years, one's classification automatically becomes Active or Associate, subject to the approval of the Board of Directors. The yearly dues are changed accordingly and no entrance fee is required to make the transfer. There shall be no other foreign junior membership.

ARTICLE III

ADMISSION, TRANSFER AND EXPULSION OF MEMBERS

SECTION 1. *Application* for admission to membership shall be on a form prescribed by the Board of Directors, and shall embody a full record of the general and technical education of the applicant and of his professional career. Forms shall be signed by the applicant and at least three members by whom the applicant is personally known and shall be approved by the Board of Directors.

SECTION 2. In the event of unfavorable replies or failure to receive replies from references, the applicant may be called upon to give further references. Should applicant be not personally known by three members, reference to other Engineers or Engineering Societies of recognized standing may be accepted.

SECTION 3. Reference to members to whom applicants are personally known may be waived in case of foreign applications, but the applicants shall in that case refer to at least two engineers of recognized standing.

SECTION 4. *Admission* to Honorary and Life Membership shall require nomination by unanimous vote of the Board of Directors, and election by vote of not less than three-fourths of Active members present at the Annual Meeting.

SECTION 5. *Admission* of Active and Associate members shall be by unanimous vote of the Board of Directors after application has been made in due form and by payment of entrance fee and payment of dues.

SECTION 6. *Admission* to Junior Membership shall be by unanimous vote of the Board of Directors after application has been submitted in due form, and without payment of entrance fee and after payment of dues.

SECTION 7. *Transfer* from one grade of membership to another shall be made in accordance with this Constitution by application to the Board of Directors, whose decision by unanimous vote shall be final. Junior memberships can be transferred to Active or Associate memberships at any time with the approval of the Board by payment of regular dues for such membership.

SECTION 8. Notice of resignation from membership shall be reported to the Board of Directors whereupon if all of the member's dues and other indebtedness to the Association have been paid, the resignation in good standing shall be accepted and his name removed from the roll.

SECTION 9. Expulsion of a member shall be considered by the Board of Directors at the written request of ten members.

Should there be sufficient cause, the accused shall be advised of the charges made and shall be given opportunity to make a defense at a meeting of the Board of Directors, of which meeting he shall receive at least twenty days' notice. If satisfactory defense is not made, the accused may, by unanimous vote of the Board of Directors, be expelled from membership.

SECTION 10. Any person elected to membership who shall fail to qualify by payment of entrance fee and annual dues within two months after notice of his election may be considered to have declined

his election, and his election may be declared void by the Board of Directors.

Any member whose dues remain unpaid for more than six months after the date when they are due and payable may by order of the Board of Directors be suspended from the Association until his dues shall have been paid. During suspension his rights to attend meetings and to avail of other privileges of the Association shall also be suspended. Three months from the date on which the dues are payable, all members in arrears shall be notified, quoting this paragraph of the Constitution.

If the dues of any member remain unpaid for a term of one year, the name of such defaulting member may be stricken from the rolls of the Association by order of the Board of Directors, and thereupon all his rights in the property of the Association shall be forfeited.

SECTION 11. *Termination* of membership in the Association for any reason what-so-ever, nullifies all further rights and privileges in the Association and the use of all property thereof.

SECTION 12. Reinstatement may, by unanimous vote of the Board of Directors, be made within two years from termination of membership, without payment of entrance fee. Original date of election may be retained by payment of all back dues.

A complete file of the proceedings corresponding with such payment may be furnished, provided same are available.

ARTICLE IV

DUES

SECTION 1. The entrance fee for Active and Associate membership in the United States or Canada is $10.00 and the yearly dues $10.00 which include the payment of a year's subscription to the official magazine of the Association. The yearly dues for Junior membership is $5.00, and no entrance fee is required. If admission is made after July 1, the dues are $5.00 for Active or Associate membership and $2.50 for Junior membership. Honorary and Life memberships are exempt from all payments of entrance and membership fees. The annual dues for foreign members both Active and Associate shall be $12.50. Foreign membership shall include all members other than those in the United States and Canada.

ARTICLE V

OFFICERS

SECTION 1. The officers of the Association shall consist of five members: a President, First Vice President, Second Vice President, a Secretary and a Treasurer.

SECTION 2. The President, Vice President and Directors shall serve for one year and shall not be eligible for an immediate election to the same office. The Secretary and Treasurer may be successively re-elected from year to year. Honorary Directors may also be re-elected to the same office from year to year. The officers for the ensuing year shall be elected at each annual meeting and shall hold office for one year beginning the *first day of January.*

SECTION 3. A vacancy in the Office of President shall be filled by the First Vice President. A vacancy in the office of the First Vice President shall be filled by the Second Vice President. Any other vacancies shall be provided for by the Board of Directors for the unexpired term. Such succession to office or appointment by the Board of Directors shall not render an officer ineligible for immediate election to the same office at the next annual meeting.

SECTION 4. No officer shall receive, directly or indirectly, any salary from the Association, either as such officer or in any other capacity.

SECTION 5. No officer shall be interested, directly or indirectly, in any contract relating to the operations conducted by the Association, nor in any contract for furnishing supplies thereto.

ARTICLE VI

ELECTION OF OFFICERS AND DIRECTORS

SECTION 1. The Board of Directors shall furnish the secretary a list of nominees for offices falling vacant and for Director-At-Large *not later than ninety days previous to date of the annual meeting.*

SECTION 2. The secretary shall mail the ballot on official form to all members in good standing *not later than 75 days before the date of annual meeting.*

SECTION 3. Members not wishing to vote for the nominees whose names are printed on the official ballot, may substitute the names of any eligible members.

SECTION 4. The voting shall be by secret letter ballot, the voter signing his name on an outside envelope and the ballot enclosed in an inner sealed and unmarked envelope. To be considered all ballots must reach the Secretary *60 days before the Annual Convention.* The result of the election shall be announced at the Annual Meeting of the Association.

SECTION 5. Only Active Members (as defined in Article II, Section 6) shall be eligible to hold office.

SECTION 6. The President shall appoint three Active members, not members of the Board of Directors, to constitute a Committee of Tellers. The Secretary shall deliver to the Tellers, unopened, all ballots received by him; marking the outside envelopes received from members not entitled to vote. The Tellers shall open only the envelopes that are not thus marked, and shall proceed in secret to count the votes received. All ballots and unopened envelopes shall be returned to the Secretary, who shall preserve them for one month after the Annual Meeting. The Tellers shall hand a signed report of the results of the vote to the President, who shall read this report at the Annual Meeting, and shall declare, duly elected, the eligible persons receiving the greatest number of votes for the respective offices.

ARTICLE VII

MANAGEMENT

SECTION 1. The control of the affairs of the Association shall be vested in a Board of Directors.

SECTION 2. The Board of Directors shall be made up of the President, First and Second Vice Presidents, the Secretary, the Treasurer, the two junior Past Presidents, a Director from each Engineering classification, a Director from each District section, a Director-at-large and Honorary Directors.

SECTION 3. There shall be a Board of Advisors composed of all living Past Presidents, who are active members or life members elected by the Board of Directors under the provisions of Article II, Section 5.

SECTION 4. The detail affairs of the Association shall be handled by a Managing Director under the supervision of the Board of Directors.

BOARD OF DIRECTORS

SECTION 5. The ordinary affairs of the Association shall be under the control of the Board of Directors in accordance with the Constitution and the general provisions of the laws under which the Association is incorporated.

SECTION 6. The Board of Directors shall control the investment and care of the funds of the Association, shall make appropriations for specific purposes, shall pass upon all applications for admission, shall act upon all questions of expulsion of members, shall approve the appointment of all employees and the fixing of their salaries. The Managing Director shall submit the Annual Budget for the compensation of the headquarter's staff to the Board of Directors for their approval. The Board of Directors shall in general direct the business of the Association either itself or through the officers and committees.

SECTION 7. The Board of Directors shall adopt by-laws which shall govern its procedure and that of its Officers, Committees and Managing Director. Such by-laws shall be adopted or may be amended by a two-thirds vote of the Board of Directors in person or in writing. The text of a proposed By-Law or Amendment shall be furnished in writing to each member of the Board of Directors at least ten days before the meeting at which a vote of the same is to be taken.

SECTION 8. The Board of Directors shall appoint a reliable financial institution to act as Trustee for the funds of the Association.

SECTION 9. District Sections may be established in such locations as may be deemed advisable by the Board of Directors.

SECTION 10. The District Chairman shall be elected by a majority vote of the Active members of the section of which he is a member.

SECTION 11. The Board of Directors shall approve the appointment of the Secretaries of the District Sections as selected by the District Chairman. These Secretaries shall be under the direction of the President and Managing Director of the Association.

SECTION 12. Six members, in person shall constitute a quorum of the Board of Directors.

SECTION 13. The "Vote of the Board of Directors" shall in all cases be the vote of a majority of the members present or represented by proxy.

THE PRESIDENT

SECTION 14. The President shall have general supervision of the affairs of the Association under the direction of the Board of Directors. He shall preside at the meetings of the Association and of the Board of Directors at which he may be present and shall be exofficio a member of all committees. The Vice Presidents in order of official rank shall preside at meetings of the Association and Board of Directors in the absence of the President and shall discharge all his duties in case of vacancy in the office. The President shall appoint the following standing committees: Meetings and Editorial Committee, Membership Committee, Educational Committee, and Standardization Committee. The President may also appoint other committees as required.

SECTION 15. The organization, procedure and duties of the several standing committees other than those covered by the Constitution shall be set forth in the By-Laws of the Association.

SECTION 16. The President shall furnish the Board of Directors a

quarterly statement of the receipts and expenditures as given in the Auditor's Report.

THE SECRETARY

SECTION 17. The Secretary shall himself or through the Managing Director, prepare the business for the meetings of the Board of Directors and record the proceedings thereof. He shall, as instructed by the President, notify the officers and Directors of meetings and of any other activity to which it is their duty to attend. The Secretary shall confer with the Managing Director and co-operate with him to the fullest extent in preparation of material for meetings and reports which must be presented from time to time for consideration of the Officers and Directors of the Association.

THE TREASURER

SECTION 18. The Treasurer, under the direction of the Board of Directors, shall have general supervision over the funds and accounts of the Association.

ALL COMMITTEES

SECTION 19. All committees shall be directly responsible to the Board of Directors and shall act under its direction. The Board of Directors may at any time require the President to remove any or all members of the Committees and appoint successors. The term of the members of all standing and temporary committees shall terminate with the appointment of their successors.

EXECUTIVE COMMITTEE

SECTION 20. The Chairman of this Committee shall be the President of the Association. The members of this Committee shall be the First Vice President, Second Vice President, two Past Presidents on the Board of Directors, the Secretary and Treasurer of the Association. The duties of the Executive Committee shall be to develop further activities for the Association, suggest new policies as activities expand and the organization grows and in general to increase the effectiveness and usefulness of this Association to the Iron and Steel Industry. The recommendations of this Committee shall be submitted to the Board of Directors.

THE FINANCE COMMITTEE

SECTION 21. The Finance Committee, under the direction of the Board of Directors, shall have supervision of the financial affairs of the Association. It shall employ a certified public accountant to audit the accounts annually, and send a written report to the Board of Directors not later than March 1st. This Committee will consist of the Treasurer as Chairman and two members of the Board of Directors to be selected by the Chairman and approved by the Board of Directors.

MEETINGS AND EDITORIAL COMMITTEE

SECTION 22. The Meetings and Editorial Committee shall act in an advisory capacity to the Board of Directors regarding the editorial features of the official magazine and such other publications as are deemed advisable; shall have direct charge of the supervision and details of the program of conferences and conventions and shall give consideration to the technical programs of the District Sections.

THE MEMBERSHIP COMMITTEE

SECTION 23. The Membership Committee shall issue all application forms for membership, receive and pass upon all signed applications, and report its recommendations to the Board of Directors, which shall in turn act upon each application, after which the Secretary shall notify applicant of result. The duties of this Committee shall include the general supervision of the building up of the membership of the Association.

EDUCATIONAL COMMITTEE

SECTION 24. The Educational Committee shall have general supervision of all Educational projects authorized by the Board of Directors.

STANDARDIZATION COMMITTEE

SECTION 25. The Standardization Committee shall have general supervision of all standardization work authorized by the Board of Directors. The General Chairman of this Committee shall select the committees according to the nature of each standardization project undertaken.

TRUSTEE

SECTION 26. The Trustee shall be a reliable financial institution, selected by the Board of Directors by written agreement or instrument, who shall take care of all the funds of the Association thereto entrusted. The Trustee shall invest such funds as may be ordered by the Board of Directors and shall pay all bills when approved by the President and Managing Director. The Trustee shall furnish monthly a financial statement of the funds of the Association entrusted to the said financial institution.

MANAGING DIRECTOR

SECTION 27. A Managing Director shall be appointed by the Board of Directors to handle the detail business of the Association under the general supervision of the President and Board of Directors at a remuneration which shall be agreed upon with the Board of Directors. The Managing Director shall have a seat on the Board of Directors but no vote. The contract with the Managing Director must be signed for the Association by the President and attested by the Secretary at the time of its execution, after being properly executed by the Managing Director.

SECTION 28. The duties of the Managing Director shall consist of managing the work of the Association, the preparation of the business for all meetings of the National Association, and record of the proceedings thereof. He shall personally certify to the accuracy of bills and vouchers on which money is to be paid, before they are submitted to the President for approval. Under the general supervision of the Treasurer, he shall be responsible for keeping a record of the financial affairs of the Association. He shall prepare an annual balance sheet compiled from the auditor's quarterly reports for consideration of the Board of Directors as soon as possible after the completion of the Association fiscal year, publish the Association's periodical, superintend and manage Iron and Steel Expositions and other similar programs sponsored by the Association, and arrange for technical sessions, under the general supervision of the Board of Directors.

SECTION 29. The Managing Director shall be responsible for the proper conduct of the Association's correspondence and shall be furnished by all committee Chairmen, copies of such correspondence as they may handle directly for file in the Association's records.

SECTION 30. The Managing Director will have charge of the business office of the Association and maintain such an office force as may in his judgment be required to handle the affairs of the Association, subject to the approval of the Board of Directors.

SECTION 31. The Managing Director will receive all moneys due and turn them over promptly to the Trustee, for credit to the Association's accounts. He shall report monthly all such deposits to the President and Treasurer of the Association who will acknowledge same.

SECTION 32. The Managing Director shall furnish a Bond satisfactory to the Board of Directors.

SECTION 33. The Managing Director shall have a seat on all the standing committees as provided by this Constitution.

THE BOARD OF ADVISORS

SECTION 34. The Board of Advisors shall be made up of all living Past Presidents, shall pass on all matters referred to them by the Board of Directors, but no member of the Board of Directors, sitting on the Board of Advisors, shall have a vote on the Board of Advisors. Meetings shall be at the call of the Chairman of the Board of Advisors.

SECTION 35. The first Chairman of the Board shall be the senior living Past President, in point of service as President of the Association. He shall hold office for one year and then be succeeded by the next in rank of seniority; the succession to follow the same course from year to year.

SECTION 36. The Board of Advisors may not of themselves originate any business or legislation, but can only act when called upon by the Board of Directors.

SECTION 37. Any extraordinary affairs of the Association; such as matters of policy; changes in the purpose of the Association; expenditure of invested funds; revision of the Constitution; and any business which the Board of Directors deem advisable, shall be referred to the Board of Advisors by the Board of Directors.

SECTION 38. Any question which is considered of sufficient weight by a quorum of the Board of Directors at a stated meeting, may be submitted to the Board of Advisors, for their opinion.

SECTION 39. In submitting a question to the Board of Advisors, a written statement for each member, covering the matter involved with the reasons for or against, shall be sent under registered mail to the Chairman of the Board of Advisors. The statements shall be inclosed in addressed and stamped envelopes, unsealed, so that the chairman may insert any statement or suggestion regarding the question which he may deem advisable. After reviewing the subject each member of the Board of Advisors shall send his written and signed opinion to the Chairman who shall hand the decision, as represented by the majority of the Board of Advisors to the President of the Association to report to the Board of Directors at its next meeting. Should the Board of Advisors fail to render opinion on any question referred to them by the Board of Directors within 90 days from date of such request the matter will automatically return to the Board of Directors for decision.

SECTION 40. The Chairman of the Board of Advisors shall at any time upon request by the Board of Directors through the President within 30 days after rendering an opinion, submit for the inspection of the board, all papers, including the individual opinions of its members covering the question.

SECTION 41. Should the Board of Advisors submit a negative recommendation on a proposal to amend the Constitution, such recommendation may in affect lay the proposal on the table for a year.

A negative recommendation on any other question submitted to the Board of Advisors, unless concurred in by the Board of Directors, shall be submitted to the membership for decision at the next Annual Meeting.

ARTICLE VIII

MEETINGS

SECTION 1. The Annual Meeting of the Board of Directors shall be held not later than March 1st. The Past President shall prepare a report of the activities of the Association during his term of office to be presented at the Annual Meeting of the Board of Directors. All committee chairmen shall prepare complete reports in writing which shall be read by the Secretary at the Annual Meeting of the Board of Directors following their term as chairman. The Treasurer shall at this Annual Meeting submit a certified report showing all the investments and other properties owned by the Association, the value of the property acquired, also the amount of the appropriations and expenditures for the past fiscal year.

SECTION 2. There shall also be held an Annual Meeting of the Association for the presentation and discussion of professional papers, to conduct an Iron and Steel Exposition and for the transaction of such other business as may be properly brought before it. The time and place of such meeting shall be fixed by the Board of Directors.

SECTION 3. Other Meetings of the Association may be held at such times and places as the Board of Directors shall select. Notice of all Meetings shall be sent to all members at least fourteen days in advance.

ARTICLE IX

GENERAL

SECTION 1. A quorum of the Association shall consist of 10 per cent of the total number of Active Members in good standing, either present or represented by proxy.

SECTION 2. Every member entitled to a vote at any meeting may so vote by proxy. Every proxy shall be executed in duplicate in writing by the member himself, or by his duly authorized attorney, and one copy thereof shall be filed with the Secretary before the date on which it is to be voted. No proxy shall be valid after the expiration of eleven (11) months from date of its execution, unless the member executing it shall have specified therein the length of time it is to be continued in force, which shall be for some limited period.

SECTION 3. The fiscal year of the Association shall begin January 1st.

ARTICLE X

AMENDMENTS

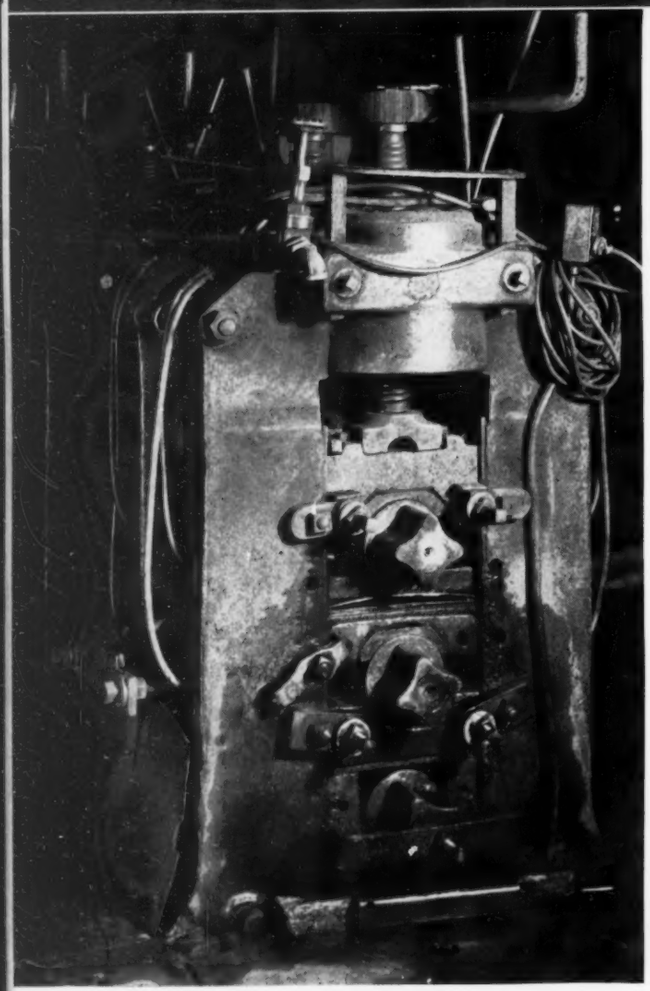
SECTION 1. Proposals to amend the Constitution shall be made in writing to the Board of Directors, signed by not less than ten members in good standing, or by resolution of Board of Directors. The revision as decided upon by the Board of Directors shall then be referred to the Board of Advisors not later than January 15th for their approval. After being received by the President, from the chairman of the Board of Advisors, it shall if approved be placed in the hands of the Secretary not later than April 15th. He shall send copies of it to all Active Members in good standing not later than May 15th.

SECTION 2. The Secretary's affidavit of having mailed such copies shall be presumptive evidence of notice having been given.

SECTION 3. Ballots on amendments shall be sent to the Secretary in sealed envelopes and counted at the Annual Meeting of the Association by a Committee of Tellers.

SECTION 4. If two-thirds of all the members voting declare in favor of the amendment, same shall become a part of this Constitution and become effective the beginning of the next succeeding fiscal year.

SECTION 5. No amendment to this Constitution shall abbreviate the term of any Officer elected prior to the adoption of the Amendment.



TOP ILLUSTRATION—

9" Bar Mill at Watervliet Plant of Allegheny-Ludlum Steel Corporation.

LOWER ILLUSTRATION—

Note simplicity of installation of Ryertex Bearings and their water lubrication by 5/16" rubber tubes through the housings.

Allegheny-Ludlum Cuts Costs with Ryertex Bearings

25% Power Saving on 9" Bar Mill Rolling High Carbon, Stainless and Valve Steels

First Ryertex bearings were installed in this mill in February, 1935. Records show the average life of a Ryertex Bearing on this mill (rolling ½" to 1⅛" high carbon, stainless and valve steels) has been 7,500,000 lbs. or 15 times the life of Brass. Equally important is a power saving of 25% — also a large lubrication saving through elimination of grease as Rytertex Bearings are water lubricated. With these bearings the roll necks do not heat up, They have high compression strength and wear slowly making it much easier to hold to size.

Ryertex water lubricated bearings are in use on all other types of mills. We shall be glad to send you actual performance data on any type of installation in which you are interested. Write for Bulletin 42E.

Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON

Automatic Atomic HYDROGEN WELDING of Steel

By J. T. CATLETT

Industrial and Welding Engineering Department

GENERAL ELECTRIC COMPANY

SCHENECTADY, NEW YORK

Presented before the A. I. S. E. Annual Convention at Pittsburgh, Pa., Sept. 26-29, 1939

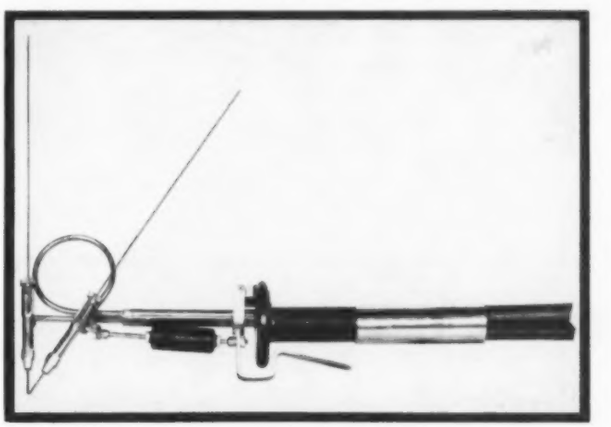
▲ THE story of iron and steel is closely connected with the history of civilization. The beginning of the story has been lost in the obscurity of unwritten history, but certainly iron and steel have played important roles in both peace and war, so important that without them modern civilization seems impossible. One cannot read this interesting story without the conviction that the military conquests and subsequent rise of successive civilizations were largely due to a superior knowledge of iron and steel.

Because of the perishable nature of iron and steel, concrete evidences of their earliest use have been destroyed. The Bible frequently mentions the use of iron, the first being in reference to Tubal-Cain, seven generations from Adam. Records of Chinese history indicate the use of iron at least two thousand years before Christ. By the time of Moses, or about 1600 B.C., the use of iron is unmistakable and some knowledge of steel is discernible. Homer, who lived about 850 years before Christ, mentions tempering by plunging into cold water. By the time of Alexander, the use of steel for both peaceful and warlike tools is quite evident. The Romans, particularly in the few centuries near the beginning of the Christian era, were skilled in the use of steel, the highest quality of which they obtained from Spain, whose streams were thought to contain water having unusual power to temper steel. To Spain we owe the Catalan forge, in which were produced the finer implements of peace and war until comparatively modern times.

From the early years of the Christian era until the close of the eighteenth century, considerable knowledge of the manufacture and use of iron was accumulated and the foundation laid for the tremendous growth which was to follow. In this period, we find the crude predecessor of the blast furnace, temperatures sufficiently high to permit pouring, some indication of the crucible process, and the use of coal in conjunction with charcoal as a fuel. This accumulated knowledge began to bear fruit in the early years of the nineteenth century, when we find charcoal being supplanted by anthracite coal, bituminous coal and coke, an improved blast furnace using preheated, power-driven air to increase production and efficiency, the introduction of the crucible, the Bessemer, and the Siemens-Martin or open-hearth processes, and the recarburization method developed by Mushet.

No evidence has been found of the use of iron and steel in America before its colonization by European nations. The first furnace was built in Virginia in 1619

FIGURE 1—In the use of the atomic hydrogen arc-welding process' the simplest equipment is the hand torch.



but produced practically no iron because of Indian massacres. The first successful iron works was established near Lynn, Massachusetts, in 1642, where in 1645 there was cast a small pot, weighing two pounds, thirteen ounces, the first article made of American iron.

The first iron ship was built about 1825, to be followed by the Monitor and the Merrimac of Civil War fame, and the steel hulls of our modern ships. About the same time, the first steel-clad rails were used, to be followed in 1832 by the first T-rail and, in the last quarter of the nineteenth century and the early part of the twentieth century, by the expansion of the railroad industry. Thus was created the demand which has made possible the great steel industry of today.

Until the close of the nineteenth century, the joining of steel was by soldering, brazing, forge welding, or by mechanical methods, such as riveting. Soldering and brazing were no doubt used in early times, since the temperatures required are comparatively low. The use of forge welding probably followed very closely the use of bellows to increase the temperature of the wood or charcoal fire. The use of these methods was necessarily limited to the fabrication of comparatively small articles. For the construction of bridges, ships, boilers, and similar fabrications, riveting or some other mechanical means of joining steel was the only available method.

Except for forge welding, the history of welding is comparatively brief. While some form of blow-pipe was probably used centuries ago for developing welding temperatures, the forerunner of the modern oxy-acetylene torch was built by Edmund Fouche of Paris, in 1901. The several methods of electric welding were developed about 1880-1890. This includes the Bernardos or carbon arc processes, the Slavianoff or bare wire metallic arc process, and the first electric resistance welder. The World War gave an impetus to welding, particularly oxy-acetylene welding, and the industrial expansion in the decades since the War has resulted in increasing the knowledge and usefulness of all our welding processes. They are largely replacing the mechanical methods of joining steel and are likely to furnish the next impetus for further expansion of the steel industry.

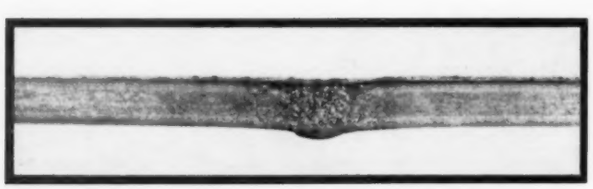
One of the more recent developments in welding is the atomic hydrogen process. Hydrogen gas, as commonly furnished for commercial purposes, is in the molecular state and, in the language of the chemist and physicist, diatomic: that is, each molecule consists of two atoms. If an electric arc is established in commercial or molecular hydrogen, the gas immediately surrounding the arc stream is transformed by the temperature of the arc and is no longer in the molecular state. The molecules have been separated into their component parts, atoms, and in this state the gas is called atomic hydrogen.

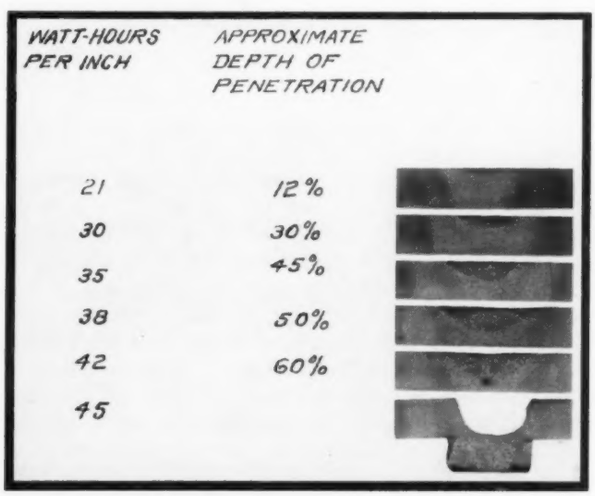
Atomic hydrogen is not a stable form of the gas. It is extremely active and will combine with other elements to form stable compounds, or with other hydrogen atoms to form molecular hydrogen, in which form it is stable. In recombining to form molecular hydrogen, the energy supplied by the arc and absorbed during the transformation to atomic hydrogen is released in the form of heat at a temperature sufficiently high to quickly raise any metal to its melting point.

In the use of this process, the simplest equipment is that used for hand welding. The electrical circuit for supplying current to the arc may be arranged in a number of different ways. Alternating current is generally used, and all that is required is that the open circuit voltage be such as to permit ease in starting the arc and that the arc current be adjustable over the required range. The basic tool, familiar to every operator, is the electrode holder. It is the means by which the arc is maintained in an atmosphere of hydrogen in such a manner that the available energy can be applied to the welding problem. It consists of two current carrying members of tubular form whose functions are the conducting of hydrogen as well as current. An insulated handle is molded over one end of these tubes to which connections are made to both sources of supply. On the other end of each of these members is mounted a clamp for holding a tungsten electrode and for providing a jet of hydrogen which entirely surrounds the electrode. The clamps are arranged so that the electrodes converge at an angle of about 60 degrees, with the arcing ends meeting on the confluent stream of hydrogen. One of the tubes contains a flexible loop so connected to a trigger on the handle that exerting pressure on the trigger separates the electrodes, and

FIGURE 2—Section of weld on 1/8 in. material with single arc equipment. Surface tension of under surface supports the molten metal. (below)

FIGURE 3—On 3/8 in. material there is a tendency to spill through when liquid metal exceeds 60 per cent of plate thickness. (right)





releasing the pressure causes the electrodes to come together.

With connections to the hydrogen supply and to the electrical power source properly made, the operator, by alternately exciting and releasing pressure on the trigger, can readily establish an arc and, by varying the pressure on the trigger, can control its size. The arc stream or "fan," as it is frequently called, follows a path very similar in shape to a horse-shoe, suspended by its legs from the arcing tips of the electrode, expanding or contracting as the distance between the tips is increased or decreased.

The electrode holder is carried so that the arc fan is vertical and approximately parallel to the line of weld, causing the heat to be applied over an elongated area whose length lies along the line of weld and is approximately four times its width. As the highest temperature exists in the arc stream, the normal practice is to carry the arc so that the lower fringe of the fan just touches the welding surface. In this way, the energy is applied at the highest temperature and results in the narrowest weld. A fortunate characteristic of the arc fan is that the lower fringe which is applied to the work is semicircular. This results in energy being applied to areas both in front of and behind the fusion area at a temperature which rapidly decreases with the distance from the arc stream. The forward area serves as a preheating zone, and the rear area reduces the quenching action of the metal adjacent to the weld which, if too rapid, is likely to entrap gas and result in porosity. Raising the arc slightly causes the energy to be applied over a larger area and at a lower temperature, and results in a wider weld and, unless the arc current is increased to compensate for the additional energy required, a reduction in welding speed or penetration. It has the advantage of further reducing the quenching action of the adjacent metal.

From the above, it is evident that there are four factors which, in an automatic welding machine, must be held as nearly constant as possible if a uniform weld is to result. Two of these—the welding speed and the vertical relationship between the welding head and the work—are relatively simple mechanical problems. Maintaining a constant value of arc current is a simple electrical problem. The fourth factor is the size or length of the arc.

One solution to this problem is in common use in all of the automatic arc welding processes, and is based on the fact that the length of an electric arc and the voltage drop across it bear a definite relationship. The usual method is to apply the arc voltage to a voltage regulator of the contact-making voltmeter type, which in turn causes a driving mechanism to feed the electrode in the proper direction to maintain a constant arc voltage between the electrode and the work or another electrode. This method, using first an alternating current regulator, and later a direct-current regulator operating through a rectifier, has been employed in the automatic atomic hydrogen process until quite recently, when a system of vacuum tubes was substituted for the voltage regulator. By eliminating the time lag in the impulse to the driving mechanism due to the inertia of moving parts of the regulator, a more uniform arc voltage can be maintained and, consequently, more uniform welding is obtained.

If the electrodes are in the same plane, the position of the fan is not entirely stable, due to the fact that the arc does not always impinge on the same point on the tip of the electrode, and will occasionally rotate on a vertical axis to a position in a plane approximately at right angles to the plane of the electrodes. The hand welding operator can momentarily reduce the welding speed until the fan returns to its normal position, but it is difficult to design an automatic machine to make

FIGURE 4—Typical section of weld made with multiple arc equipment on light gauge material. (left)

FIGURE 5—Typical section of weld made with multiple arc equipment on heavy gauge material, showing combination cast structure and forge weld. (below)

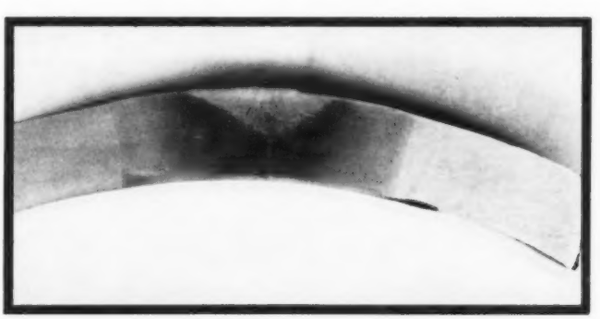
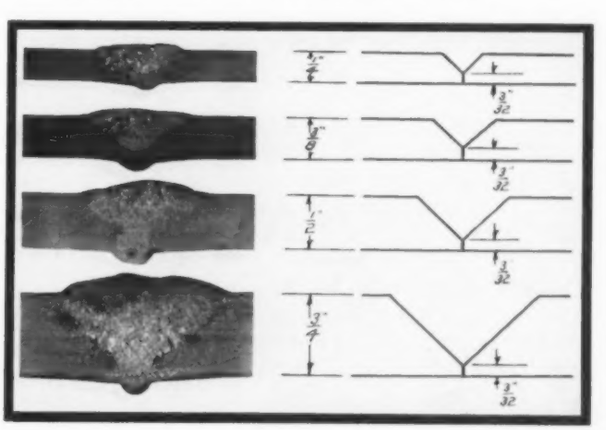


FIGURE 6—Section of weld on plates of various thicknesses, illustrating method of obtaining 100 per cent cast structure on heavy gauge material. (below)



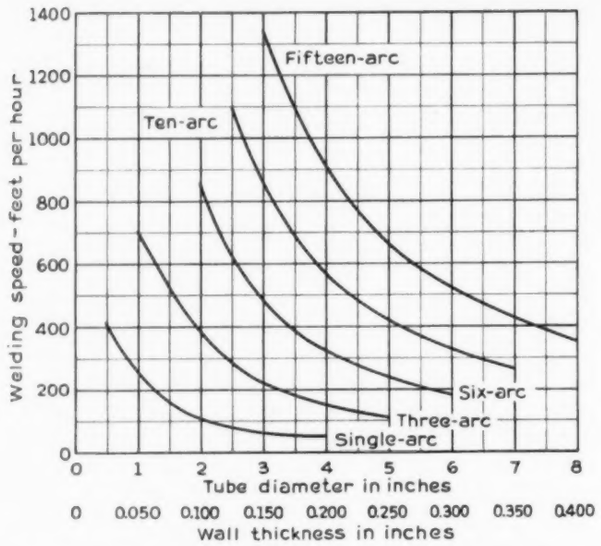


FIGURE 7—Calculated welding speeds in feet per hour on steel tubing with a ratio of outside diameter to wall thickness of 20:1. (above)

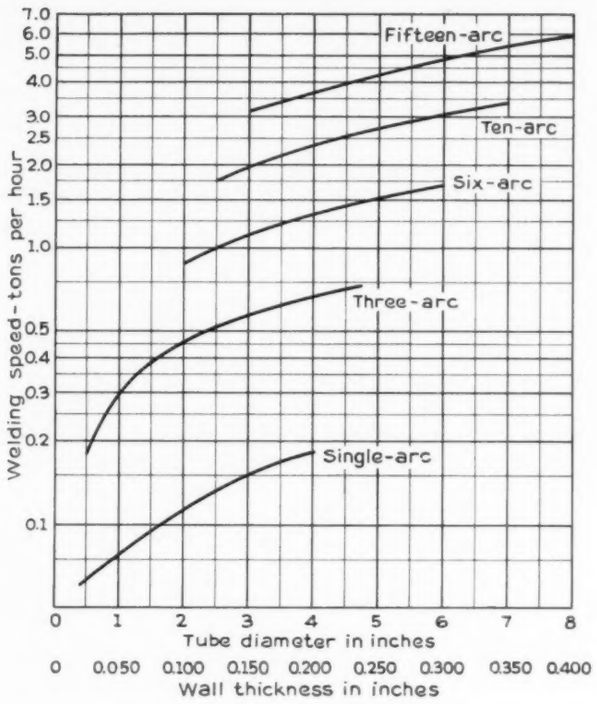


FIGURE 8—Calculated welding speeds in tons per hour on steel tubing with a ratio of outside diameter to wall thickness of 20:1. (right)

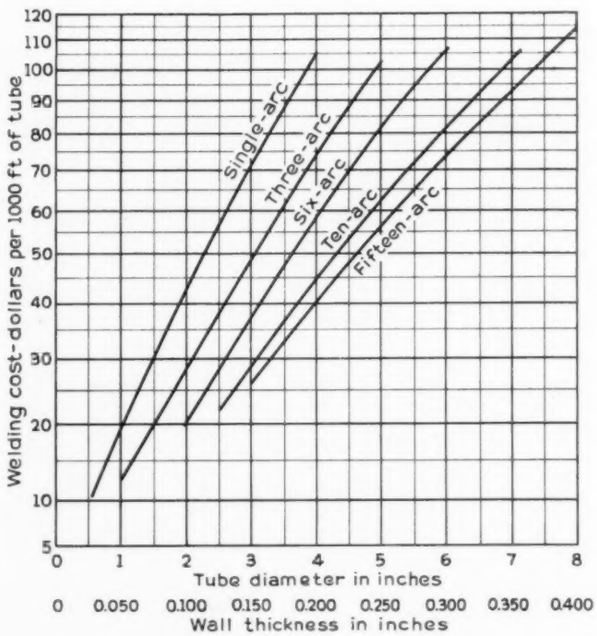
a similar compensation. If, instead of being in the same plane, the electrodes are in parallel planes slightly displaced from one another, the arc fan assumes a stable position in a plane approximately at right angles to the plane of the electrodes, making possible the use of a constant value of welding speed.

In addition to hydrogren which, by the nature of the process is present at the top of the weld, other gases may be present due to impurities in the metal or to the relatively volatile constituents of the alloy. The solubility of gases in metals increases rapidly as the temperature is raised above the melting point, and if the metal is allowed to change rapidly from the molten to the solid state, some of these gases particularly those which are being thrown out of solution, are likely to be trapped in the metal, causing porosity. A backing or chill-bar, such as is frequently used in metallic arc welding, generally has this effect, and it is better practice to avoid its use or to provide a slot in the backing bar so that it does not come in contact with the molten metal.

If the depth does not exceed approximately $\frac{3}{16}$ in., the surface tension of steel is sufficient to support the molten metal in the weld zone. When the thickness of the metal to be welded exceeds this value, some other means of support must be provided.

The most obvious way is to support it with cold or unmelted metal, or in other words, to strive for less than complete penetration. Below and at either side of the pool of molten metal is a zone in which the metal has been heated by conduction, so that its temperature

FIGURE 9—Calculated welding costs per 1000 ft. of steel tubing, using hydrogen gas.



approaches the melting point. When the depth of penetration reaches the value of 60 or 70 per cent of the plate thickness, the zone of almost-fused metal extends to the bottom of the plate, and slight variations in the welding conditions are likely to cause its temperature to reach the melting point, in which case it no longer acts as a support, and the molten metal will spill through, leaving a void instead of a weld. Therefore, this method is limited to those cases where a weld, having about 60 per cent of the strength of the plate, is satisfactory.

Perhaps the most satisfactory method is to bevel the plate at an angle of about 45 degrees to within about $\frac{3}{32}$ in. of the bottom of the plate. The edges of the plate are butted together to form a vee groove. The arc is applied so as to completely fuse the lips below the vee and form a weld whose depth is such that it will be supported by the surface tension of its lower surface. When this metal is sufficiently cool, the open vee is filled by adding filler rod in one or more additional passes until the weld is completed. The amount of filler rod required may be reduced by applying side pressure to partially close the groove. This pressure should be applied while the metal is still plastic, but not until the first pass has congealed.

As the majority of applications require more than 60 per cent penetration, single pass automatic atomic hydrogen welding is generally applied where the plate thickness is less than $\frac{3}{16}$ in. When the plate thickness exceeds this value, multiple-pass welding or its equivalent must be used.

As the maximum welding current which can be satisfactorily used in a single arc is 150 amperes, and is further limited by its relation to plate thickness, the only solution to greater production or increasing the

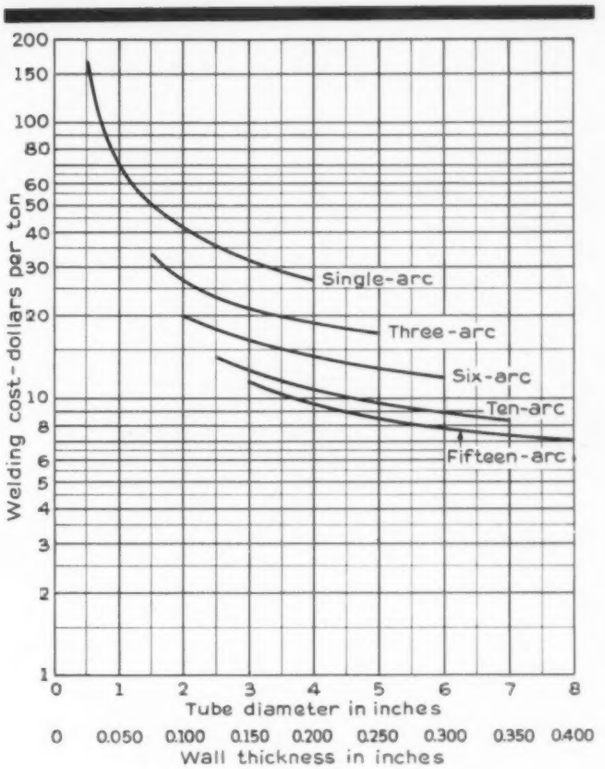
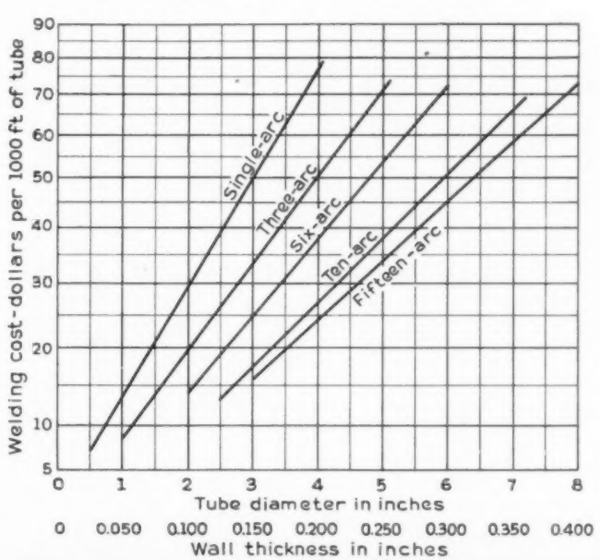
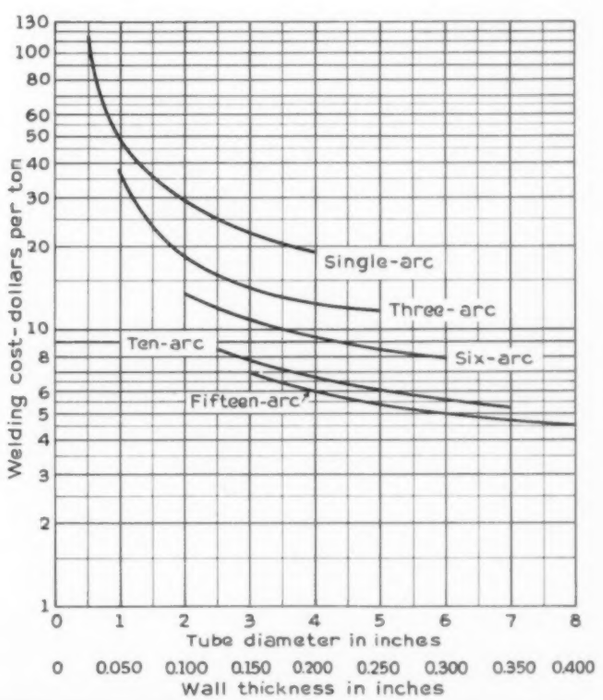


FIGURE 11—Calculated welding costs per ton of steel tubing, using hydrogen gas. (above)

FIGURE 12—Calculated welding costs per ton of steel tubing, using dissociated ammonia. (below)

FIGURE 10—Calculated welding costs per 1000 ft. of steel tubing, using dissociated ammonia.





energy available is to use more than one arc. A number of arcs may be installed as separate units, operating individually, or combined in a single multiple-arc unit. If separate units are installed, the only problem is to provide sufficient units to obtain the required production. If the required number of arcs are incorporated in a single unit, another problem is presented. This is the selection of the distance between successive arcs along the line of weld.

Since the arc itself is approximately one inch along the line of weld, and the effective heating zone is somewhat longer, the minimum spacing is 1¼ to 1½ in. Prior to the time fusion occurs, the arcs should be as closely spaced as possible, to provide a continuous heating zone of high intensity. The spacing of the remaining arcs depends largely upon the function they are to perform. With the spacing determined, the problem then becomes one of design, as the mechanism of the single-arc unit occupies about nine inches along the line of weld and this must be considerably reduced in the multiple arc unit. The first design of this type was most ably executed by Mr. Riemenschneider of the Midland Steel Products Company. This machine employs six arcs, equally spaced, and is used in the manufacture of steel tubing from formed strip, which is subsequently used in the manufacture of rear axle housings for automobiles. There is one other machine of this type in America and it is similarly employed in the manufacture of rear axle housings for trucks. This machine, employing ten arcs, was installed at the plant of the Clark Equipment Company. A third machine of six arcs is in service in England, but, unfortunately, details of its operation are not available.

Another problem closely allied with that of arc spacing is the technique of applying this elongated heating zone. In the case of the installation at the plant of the Midland Steel Products Company, the tubing is formed from hot-rolled strip in lengths of 150 to 200 ft., and approximately $\frac{5}{32}$ in. thick. The tubing is formed, welded, and cut to length in one passage through the machine. The welding head is located in the line of travel so that the leading arcs expend their energy on the seam before it is closed by the forming mill. During this time, the opposing edges become molten, the liquid metal being held by its surface tension to the unfused edges. As the tube progresses, the molten edges converge, and when they touch, the liquid metal is suspended by surface tension between the unfused edges. As the seam leaves the heating zone, sufficient side pressure is exerted to throw up a flash, both inside and outside the tube, which is then trimmed off by knives so that the thickness of the weld is the same as that of the tube. The tube is then cooled in a stream of water and cut to length by a flying shear or cut-off.

Each weld is automatically tested by the subsequent manufacturing operations. An expanding tool is inserted in the tube and a short section is bulged out, so that it is approximately 30 per cent larger in diameter. This bulge is near one end which is then slitted and flared out to form one-half of the housing banjo. Two lengths are then flash-welded together to form the complete housing.

Largely because the plate thickness is $\frac{21}{64}$ in., or approximately double that in the case just described, a different technique is employed in the application of the ten-arc head at the plant of the Clark Equipment Company. In this instance, the tubes are made from

FIGURE 13—View of installation of single arc equipment for welding alloy steel tubing.

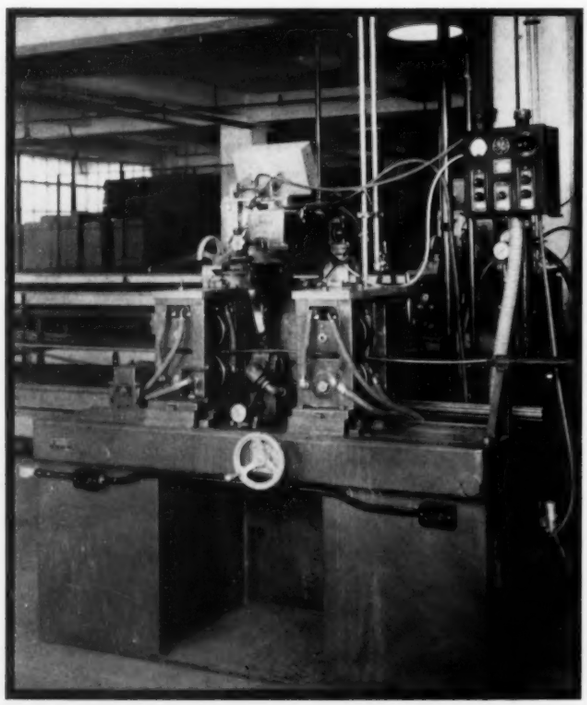
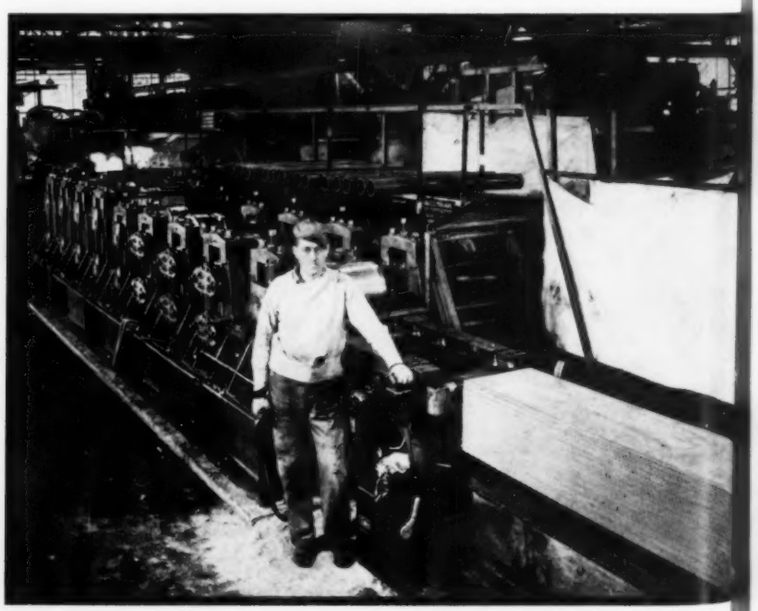


FIGURE 14—View of multiple arc equipment for welding heavy gauge steel tubes.



blanks of the required length in a forming mill, and then loaded into a propelling unit through which they progress, passing under the ten-arc welding head and through a bead-roller which rolls the seam while still hot to the same thickness as the plate.

During the passage through the forming mill, the blanks are beveled so that when formed into a tube, the included angle is approximately 90 degrees and, below the vee, the edges are radially butted for a depth of about $\frac{3}{32}$ in. As the tube passes through the propelling unit and under the welding head, side pressure is applied to close the seam, so that the leading arcs expend their energy on a vee groove which is closed at the bottom. As the tube passes under the closely spaced, leading arcs, a pool of molten metal begins to form at the bottom of the groove, being fed by molten metal which will not cling to the sloping sides. As the tube progresses, the volume of molten metal increases, and the radial edges under the pool become plastic, allowing deformation which raises the bottom of the groove thus decreasing its area. As the gradually increasing volume of molten metal and the gradually decreasing volume of the groove reach equality, the arc spacing is increased so that the molten metal remains liquid and, by conduction, raises the temperature of the unfused metal below to the point where a forge weld between the radial edges is assured. From this point on, the applied energy is decreased, so that solidification of the molten metal progresses from the bottom upward, and any contained gases escape through the molten top surface. The result is a weld whose depth is divided into two distinctly different types. The lower section, generally about one-half the plate thickness, is a forge weld, having much the same characteristics as a properly fluxed and hammered forge weld. The upper section has a cast structure, and usually shows the effect of a slight amount of hot rolling.

When the plate thickness exceeds the value above which the surface tension will not support the depth of molten metal required for complete penetration, a weld having a cast structure for the entire thickness of the plate can be obtained by a technique similar to that previously described for welding with a single arc in several passes. The edges are prepared in the manner just described. The leading arcs are employed to form a pool of molten metal of a depth which does not exceed that which will be supported by the surface tension on its under side. At this point the distance between arcs is greatly increased, allowing this pool to congeal before additional energy is applied. The solidified metal then acts as a support for molten metal added above it to complete the weld, the arc spacing and energy being such as to little more than keep the upper surface liquid and in condition to receive the filler rod which is added at intervals to supply the volume necessary to completely fill the groove. In order to reduce the amount of filler rod necessary, side pressure may be exerted after the primary weld is made to partially close the groove by upsetting the metal which remains plastic due to its close proximity to the molten pool. Solidification progresses from the bottom upward and the possible entrapment of porosity-forming gas is practically eliminated.

The cost of hydrogen is a large part of the total operating cost, and a number of attempts have been made to use a less expensive gas. So far, the most successful substitute is dissociated ammonia. This gas is prepared for use in the atomic hydrogen welding process by passing gaseous anhydrous ammonia through a furnace where, at a temperature of approximately 1650 degrees F., the compound is resolved into its constituent elements. It is then cooled and the result is a gas consisting of 75 per cent hydrogen and 25 per cent nitrogen, which is entirely suitable for this process. The only disadvantage observed is that its cooling effect on the electrodes is not as great as that of hydrogen and must be compensated for by using an increased volume of gas. As this gas can be produced for about $4.00 per thousand cu. ft., compared with an average cost of $20.00 per thousand cu. ft. of hydrogen, the necessary increase of approximately 20 per cent in volume still allows a substantial saving to be made.

Operating cost data for the application of the process to the range of plate thicknesses to which it is adaptable are supplied in the form of curves. Since there are a limited number of single-arc and only two multiple-arc machines from which such data can be obtained, these curves are based entirely on calculated values. The costs of materials, labor and investment charges are based on the following: power at $.02 per kwh., tungsten electrodes $\frac{3}{32}$ in., $\frac{1}{8}$ in. and $\frac{3}{16}$ in. diameter at $.45, $.65 and $2.25 per foot respectively; hydrogen at $20.00 per 1000 cu. ft., dissociated ammonia at $4.00 per 1000 cu. ft., and labor and investment charges at $2.50 per hour per man. Calculations are based on the continuous welding of tubing having a ratio of outside diameter to wall thickness of 20:1. The allowance for labor is on the basis of one man for the single-arc, two men for the three-arc, three men for the six-arc and ten-arc, and four men for the fifteen-arc equipments.

The most popular application of the single-arc automatic equipment is the welding of light gauge chrome-nickel alloys including Inconel, Calorite and 18-8 stainless steel. The process is applicable not only to these but to practically all of the ferrous and non-ferrous alloys.

DISCUSSION

PRESENTED BY

WRAY DUDLEY, *Assistant Superintendent of Maintenance*, National Tube Company, McKeesport, Pennsylvania.

J. T. CATLETT, Industrial and Welding Engineering Department, General Electric Company, Schenectady, New York.

E. H. TURNOCK, Welding Rod Laboratory, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

WRAY DUDLEY: Mr. Catlett has presented an interesting and instructive paper concerning the atomic hydrogen welding process and in particular its application to the welding of tubing or pipe. Perhaps none of the more commonly used welding processes has received more expert attention in its development than atomic

hydrogen, and the success it has achieved in certain fields of application is a tribute to the skill and patience of the research workers who were responsible for its development into a commercial tool as well as to the courage and resourcefulness of the engineers who have applied it in the production of mechanical tubing.

The problems involved in controlling the pool of molten metal in the seam cleft of the moving tube were not easily solved in a manufacturing plant and while no figures are presented as to the percentage defects arising from drip-through, it seems evident they must be within reasonable limits or otherwise the process would have been abandoned for the production of carbon steel tubing.

The author states that the most popular application of the single arc automatic equipment is the welding of light gauge chrome-nickel alloys. From consideration of the tube welding cost figures as shown in the various curves, it would appear that the most favorable field for the multi-arc equipment likewise would be found in welding heavy gauges of the same material. Ordinary carbon steel tubing would not penetrate very far in a competitive market if burdened with welding costs of the magnitude shown.

I would like to submit the following questions:

1. Is it necessary to remove scale along the seam edges prior to welding?
2. When replenishing the tungsten electrode in the multi-arc set, is it necessary to stop welding during the replacement operation?

J. T. CATLETT: Speaking about scale, it is not necessary to remove the scale. The de-oxidizing effect of the atomic hydrogen is sufficient, you might say, to brightly anneal the surface. We do it on the heavier gauge, principally, or rather entirely, to get the conformation of the groove that is necessary for us to produce a solid weld.

Regarding the stopping of the welding machine in order to replace electrodes, yes, it is necessary. It doesn't happen frequently enough to be a great loss. We allow about six inches of tungsten wear before it is necessary to stop the machine, and at that time the tungsten is reset in the electrode holder to allow an additional six inches. With the ten-arc machine, the approximate loss per electrode per hour is one inch. So that means it would run from 4 to 6 hours without having to stop.

E. H. TURNOCK: Just one question. Will you explain the conditions that exist where you use dissociated ammonia, and how you avoid nitrides in a mild steel weld?

J. T. CATLETT: I don't know whether I can answer your question the way I would like to. We have attempted to find the nitride treating effect in atomic hydrogen welds, and when it does occur it is very slight. With the ten-arc head at Clark Equipment Company they use dissociated ammonia and we haven't located any nitrides. Whether it is a question of relative temperature or not, I am not well enough acquainted with how nitrides occur to be able to explain that.

E. H. TURNOCK: That is something we go to great length to avoid in arc welding. I wondered how you put it in an atmosphere of nitrogen and get the results you do.

J. T. CATLETT: I think it is more than likely a question of temperature, but we apparently don't get the nitriding effect you would expect.

A. I. S. E.

ANNUAL SPRING CONFERENCE

MONDAY AND TUESDAY, APRIL 1st & 2nd, 1940

HOTEL NETHERLAND PLAZA

CINCINNATI, OHIO

TECHNICAL SESSIONS, OFFERING AUTHORITATIVE PAPERS COVERING SUBJECTS OF WIDE INTEREST TO ALL STEEL MILL OPERATORS AND ENGINEERS, WILL BE HELD MONDAY MORNING AND EVENING.

INSPECTION TRIPS

Inspection Trip to the Andrews Steel Company, Newport, Kentucky, on Monday afternoon.

On Tuesday the entire day will be devoted to an Inspection Trip through the Hamilton and Middletown Works of the American Rolling Mill Company.

REPUBLIC'S WARREN FURNACE

The World's Largest

By G. F. KERWIN and T. J. ESS

▲ IN order to effect greater operating economies, as well as to obtain additional capacity for pig iron to be used in the open hearth shop of its Warren, Ohio, plant, the Republic Steel Corporation has recently completed a modernization program on the blast furnace at that plant.

It is perhaps in keeping with the traditions of this furnace that the new lines make it the largest furnace in the world. The original furnace plant, put into operation in 1921, attracted considerable interest in the industry, due to the incorporation of many ideas which at that time represented a departure from general convention. The wisdom of the design was effectively proven by the subsequent operating record of this furnace. In 1930, this furnace was rebuilt, and, in keeping with the trend at that time, considerably enlarged. The lines of the furnace then were as follows:

Hearth diameter	27 ft. 0 in.
Bosh diameter	28 ft. 6 in.
Stock line diameter	19 ft. 0 in.
Large bell diameter	14 ft. 0 in.
Small bell diameter	5 ft. 0 in.
Height, tuyere center line to closed large bell	77 ft. 0 in.
Height, iron notch to tunnel ring	91 ft. 6 in.
Bosh angle	86 deg. 36 min.
Inwall batter	1.3125 in. : 12 in.

At that time, a bolted segmental hearth jacket, reinforced by steel bands, was installed, together with new columns, mantle, and a portion of shell, all of substantial design. Just prior to this, a fourth stove had been installed, and also a new 75,000 cu. ft. per min. turbo-blower.

This furnace again attracted national attention due to its high production rates, and had produced 1,973,583 gross tons of iron when blown out August 12, 1939. The

G. F. Kerwin *(right)*, blast furnace superintendent, collaborated with T. J. Ess, of the IRON AND STEEL ENGINEER, in preparing this article.

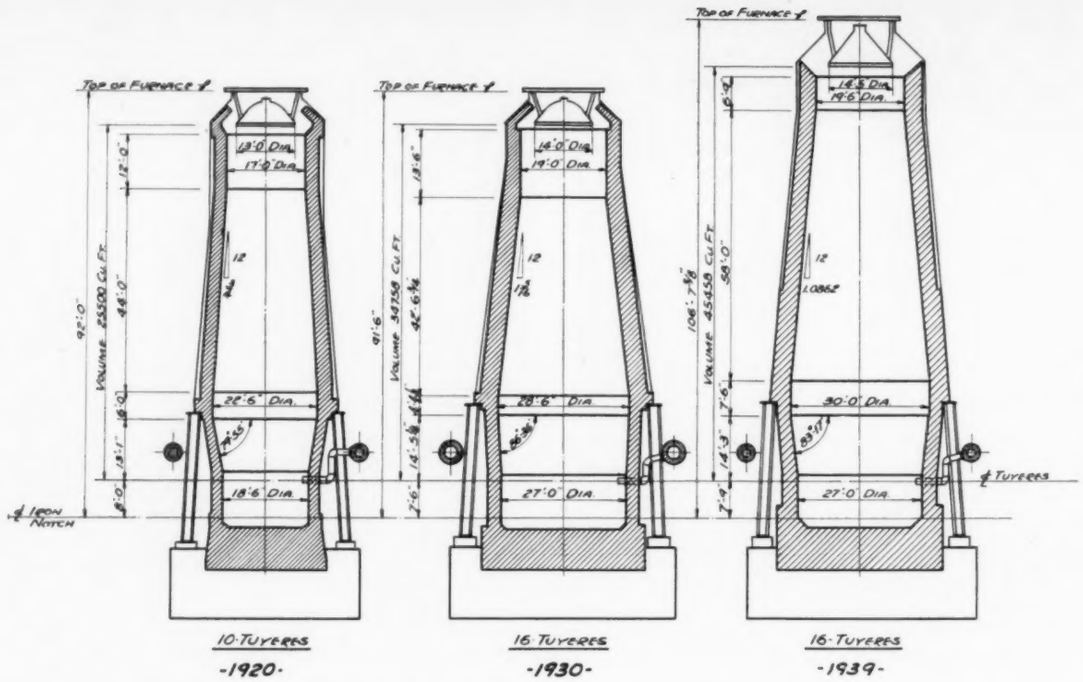


FIGURE 1—Diagrams showing lines of successive rebuilds of the Warren furnace.

campaign had averaged 997 tons of iron per day on a coke rate of 1976 lb. per ton of iron, using 72,000 cu. ft. of air per min. and a blast temperature of 1135 degrees F., and making 267 lb. of flue dust per ton of iron.

Investigation had shown that the existing furnace foundation, which rested on concrete piles, was adequate to carry the new furnace. It was further recognized that the necessary elements were present to materially improve furnace operation by going somewhat further than a straight relining job. When the furnace had previously been rebuilt, the hearth was materially enlarged, forming a vital step toward the ultimate enlargement of the new furnace. The old shell, while comparatively new, had a rather heavy batter due to the large mantle and small top diameters, coupled with the fact that the furnace was very short.

In view of the proven importance of the stock column itself in the reduction process, it was felt a larger furnace stack would give smoother and more economical operating conditions, as well as increased production. Designs were therefore prepared retaining the existing hearth jacket, tuyere jacket, columns and mantle, but calling for an increase in furnace height of 15 ft. 1⅜ in., an increased bosh diameter, and a 33⅓ per cent increase in working volume. The new lines are as follows:

Hearth diameter	27 ft. 0 in.
Bosh diameter	30 ft. 0 in.
Stock line diameter	19 ft. 6 in.
Large bell diameter	14 ft. 5 in.
Small bell diameter	6 ft. 0 in.
Height, tuyere center line to closed large bell	89 ft. 3 in.
Height, iron notch to tunnel ring	106 ft. 7⅜ in.
Bosh angle	83 deg. 17 min.
Inwall batter	1.0862 in. : 12 in.

The hearth is built up of a 4 ft. 6 in. thickness of ladle brick on the foundation mat, topped by 12 ft. of 18 in. x 9 in. x 4½ in. bottom blocks arranged in 8 rows. The furnace lining is 45 in. thick above the mantle, 36 in. thick at the hearth jacket, and 31½ in. thick at the tuyere jacket and hearth. Approximately 770,000 9 in. equivalents were used in lining the furnace. Eight rows, each of 32 cooling plates, are arranged in the furnace bosh, while 148 cooling plates are placed above the mantle, and 94 breast plates in the hearth. Sixteen

F. E. Flynn, *District Manager*

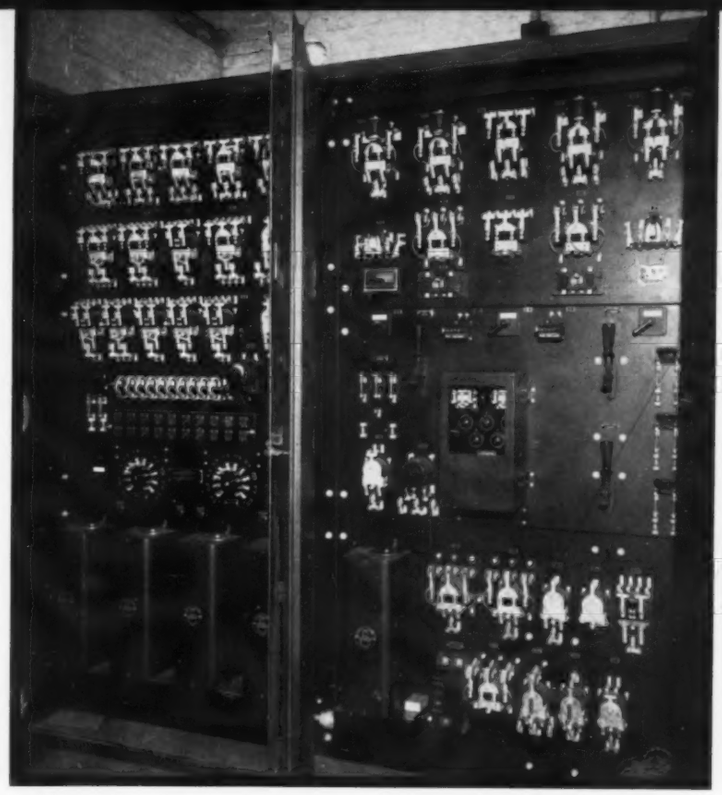
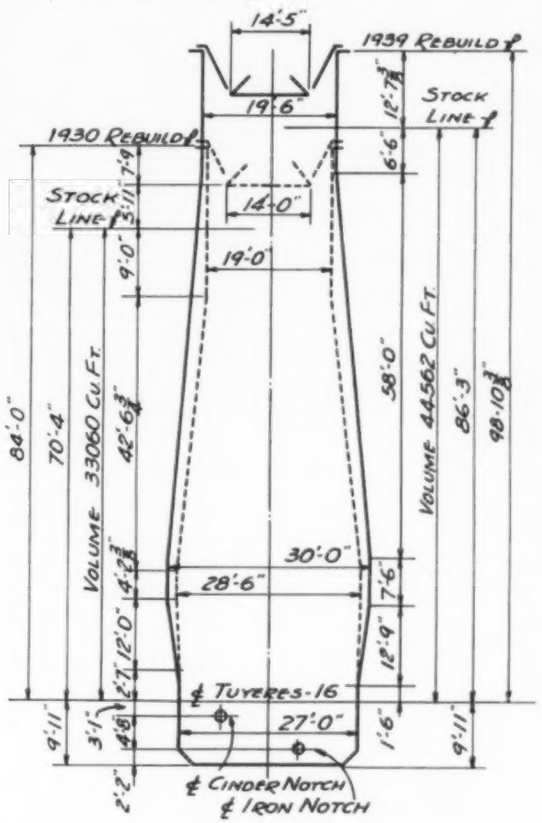


FIGURE 2—*(left)* Complete control for all charging equipment except scale car and skip is provided on this panel.

FIGURE 3—*(below)* Drawing showing new furnace lines superimposed upon the previous lines.



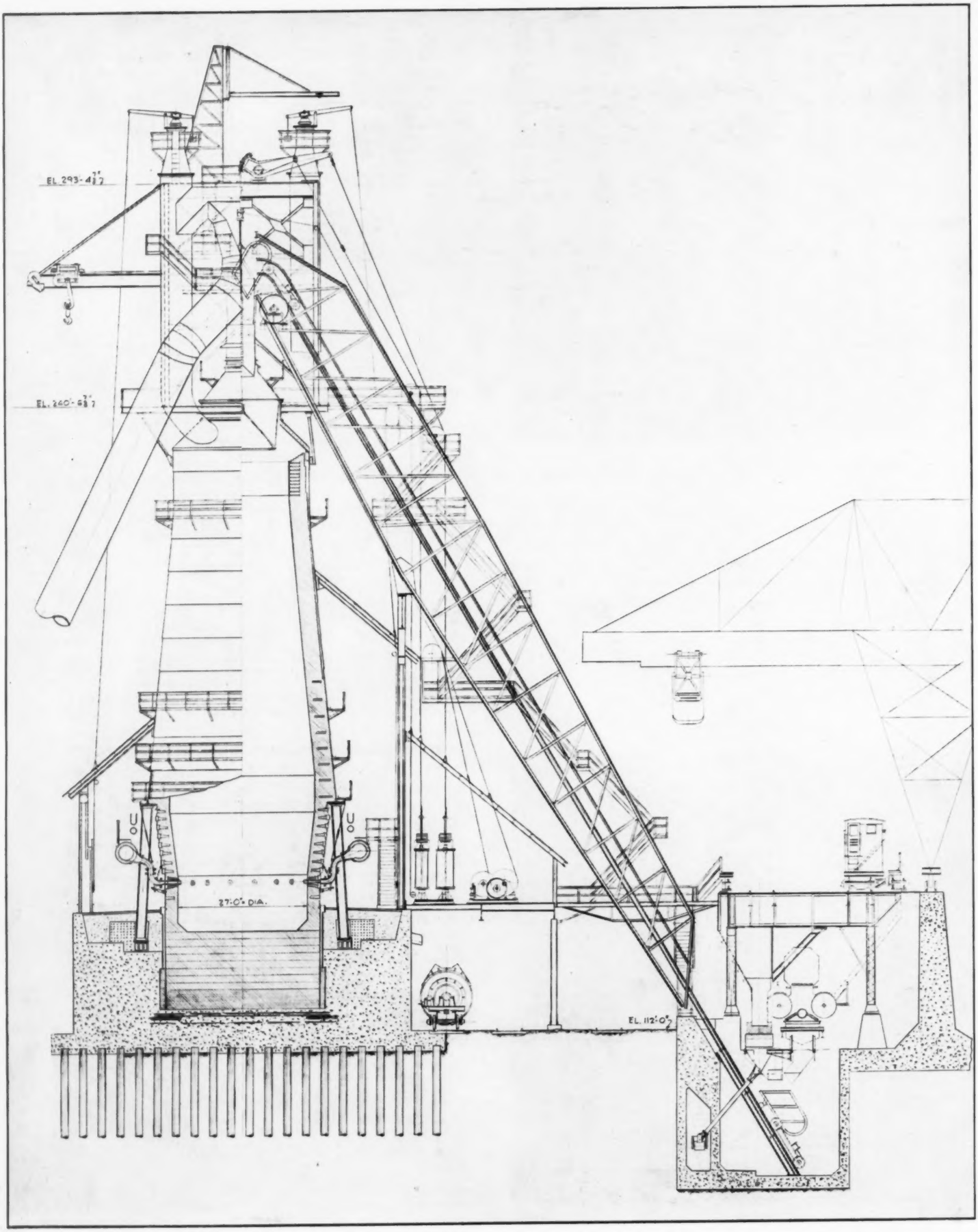
tuyeres are spaced around the furnace between the eight structural columns which support the furnace. Plate forming the shell is $1\frac{1}{8}$ in. thick for the first ring, 1 in. thick for the second, third and fourth rings, $\frac{7}{8}$ in. thick for the next six rings, while the eleventh ring is 1 in. thick. The double cone is of $\frac{3}{4}$ in. plate.

J. H. Graft, *Assistant District Manager*

Figure 1 shows a comparison of the new furnace lines with those of the previous rebuild, and additional comparison is afforded by the following figures:

	1931 Rebuild	1939 Rebuild
Rated capacity	1000	1125
Area of bell, sq. ft.	153.9	163.2
Area of stockline, sq. ft.	283.5	298.6
Ratio $\frac{\text{Area of stockline}}{\text{Area of bell}}$	1.84	1.83
Area of hearth	572.5	572.5
Ratio $\frac{\text{Volume above tuyeres}}{\text{Area of hearth}}$	58	77.8
Area of straight section, sq. ft.	637.9	706.8
Ratio $\frac{\text{Area of straight section}}{\text{Area of hearth}}$	1.12	1.23
Ratio $\frac{\text{Area of stockline}}{\text{Area of hearth}}$	.495	.525
Tons per sq. ft. of hearth area	1.74	1.95
Tons per sq. ft. of straight section area	1.57	1.58

One of the outstanding features of the new design is the height, which makes this furnace the tallest in the world, and gives it the largest effective working volume, 44,562 cu. ft. from tuyere plane to stock line. There are


EL. 293-4 7/12
EL. 240'-6 3/4
27'-0" DIA.
EL. 112'-0"

some furnaces in this country with somewhat larger hearths, but none with as large an effective working volume. The height was increased in order to obtain the desirable effect of added stock column, and exceeds the height of the furnace built at the Youngstown plant in 1938 and described in detail in the IRON AND STEEL ENGINEER, January, 1939. The stockline was made 19 ft. 6 in. in diameter, with a 14 ft. 5 in. bell, due to the excellent operating results with similar stocklines at the corporation's Cleveland and Youngstown plants. The large bell hopper has a capacity of 1345 cu. ft., which is deemed sufficient for any normal charge. A new 6 ft. small bell and a 6 ft. revolving distributor were installed. A stockline recorder is provided for either continuously or intermittently recording the stockline. The measuring rods are withdrawn from the furnace prior to the dump of the large bell.

The bells are supported directly by the furnace stack, and are operated pneumatically with cold blast air, reduced to 15 lb. per sq. in., supplemented by a standby connection to the plant compressed air system. The existing small bell operating cylinder was adequate for the new furnace, but a new, larger cylinder was required to operate the large bell, due to the use of heavier furnace charges ranging up to 100,000 lb. The operation of the bell cylinders is controlled by motor-operated cocks, interlocked with the distributor and the skip hoist, provision being made for independent control of the speed of dumping and closing the bells. The auxiliary air supply is automatically admitted through a pressure regulating valve in the event of a drop in blast pressure. Provision is made to keep the large bell closed in the event of slack cable on the large bell hoist, thereby preventing the large bell from violently dropping in case of unusual conditions. Equipment is also provided for causing the large bell to be self-opening in the event of an explosion between the bells. After explosion pressure is relieved, the large bell closes normally without attention and without shock.

The pneumatic bell hoist gives an inherent cushioning

FIGURE 4—General cross section through furnace and stock house. (left)

FIGURE 5—Signal and control panel located in the stock house also provides emergency manual control.

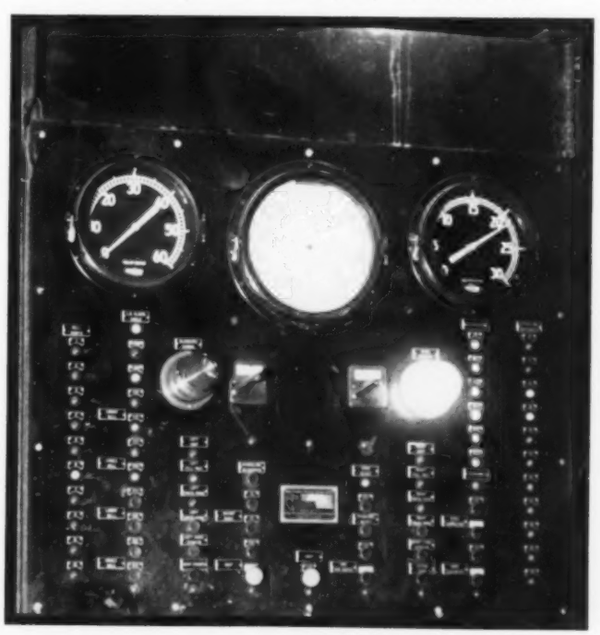


TABLE I
Record of Blow-in

Date	Time	Cu. ft. air	Blast pressure (lb.)	Blast temp. (deg. F.)	Top temp. (deg. F.)	Top pressure (in.)	Charges	Total charges
11-3	5 P.M.	10,000	1	800	...	12	..	...
	6	10,000	1	975	...	12	..	...
	7	12,000	1	1000	...	13	..	...
	8	14,000	1	1000	...	14	..	...
	9	16,000	1	1000	110	14	..	...
	10	18,000	2	1000	120	15	..	...
	11	21,000	4	1000	100	14	..	...
	12	24,000	6	1000	75	13	1	1
11-4	1 A.M.	30,000	6	1000	75	14	1	2
	2	31,000	7	1000	80	12	1	3
	3	33,000	7	1000	100	14	..	...
	4	35,000	7	1000	120	15	1	4
	5	35,000	7.5	1000	125	14	1	5
	6	35,000	8	1000	140	14	1	6
	7	36,000	8	1000	140	15	1	7
	8	37,000	8	1000	140	15	1	8
	9	39,000	8	1000	170	14	2	10
	10	40,000	10	1000	250	15	2	12
	11	40,000	10	1000	250	14	1	13
	12	40,000	10	1000	300	15	2	15
	1 P.M.	40,000	11	1000	350	14	1	16
	2	41,000	11	1000	300	15	1	17
	3	42,000	11	1000	400	14	2	19
	4	42,000	12	1000	430	16	2	21
	5	42,000	12	1000	380	17	2	23
	6	42,000	12	1000	400	16	2	25
	7	42,000	12	1000	440	17	2	27
	8	42,000	12.5	1000	380	18	2	29
	9	42,000	12.5	1000	400	17	2	31
	10	42,000	13	1000	400	16	2	33
	11	43,000	14	1000	390	18	2	35
	12	44,000	14	1000	400	17	2	37
11-5	1 A.M.	44,000	14.2	1000	500	18	2	39
	2	44,000	14.8	1000	500	18	3	42
	3	45,000	15	1000	510	20	3	45
	4	46,000	15.9	1000	530	22	2	47
	5	46,000	14	1000	530	21	2	49
	6	46,000	14	1000	630	22	2	51
	7	47,000	14	1000	665	24	2	53
	8	48,000	14	1000	690	26	2	55
	9	48,000	14	1000	740	27	2	57
	10	48,000	14	1000	600	26	3	60
	11	35,000	10	1000	660	18	3	63
	12	35,000	11	1000	790	19	3	66
	1 P.M.	35,000	12	1000	650	18	3	69
	2	40,000	12	1000	550	16	3	72
	3	43,000	13	1000	470	18	2	74
	4	46,000	15	1000	470	22	2	76
	5	46,000	15	1000	560	23	2	78
	6	46,000	14.5	1000	500	23	2	80
	7	46,000	15	1000	480	22	3	83
	8	48,000	14.5	1000	500	24	3	86
	9	48,000	15	1000	550	25	3	89
	10	48,000	15	1000	650	24	3	92
	11	49,000	15	1000	610	26	3	95
	12	50,000	15	1000	580	25	2	97
11-6	1 A.M.	50,000	15	1000	580	26	3	100
	2	50,000	15.5	1000	630	25	3	103
	3	52,000	16.5	1000	580	27	3	106
	4	52,000	17	1000	550	28	2	108
	5	52,000	16.5	1000	520	27	3	111
	6	53,000	16	1000	500	29	3	114
	7	54,000	15	1000	510	30	3	117
	8	54,000	15	1000	560	31	3	120
	9	54,000	15	1000	540	30	3	123
	10	54,000	14	1000	550	31	3	126

effect at both the open and closed position. There is no shock in the operation of the bell, and no mechanical or electrical limits are provided other than that the operating cylinder reaches the end of its travel when the bell is fully open and the bell stops itself when it reaches its seat. The pneumatic cylinders are double-acting, and the conventional counterweight on the bell beams at the top of the furnace is eliminated. The weight of the bell cylinder, plus a small counterweight on the cylinder itself keeps the bell closed when no load is on it. The weight of the load is carried by air pressure in the cylinder.

The existing skip bridge was of the cantilever type supported by an A-frame, and carrying the bells and bell beams. Due to its deep truss design, it was possible to discard the old portion above the A-frame and start a new track system at a steeper inclination up through the old structure to take care of the increased furnace height with a minimum change to the bridge. The incline has no physical connection with the top of the furnace stack. Skip cars are of the trailer or pusher type, and were increased to 200 cu. ft. capacity and equipped with anti-friction bearings. The cars are quite narrow, and the skip car tracks close together giving a desirably small receiving hopper. The existing skip hoist, of the electric double drum type, is driven by a 200 hp., 230 volt d-c. motor, and can hoist a 17,000 lb. load at a rate of 350 ft. per min., ample for all possible needs of the furnace. This hoist, together with the bell operating cylinders, is located in a brick and concrete hoist house under the skip truss and above the hot metal tracks.

Ore is received in the plant in gondola cars and unloaded by means of a movable car dumper having a 57 ft. cradle and a capacity of 320,000 lb., and capable of handling 30 cars per hour. The dumper is provided with both dynamic and air braking, and has a travel the entire length of the storage yard.

The storage yard is 505 ft. long by 270 ft. wide, with a storage capacity of 375,000 tons of ore, and is served by a 11 ton ore bridge of 600 tons per hr. capacity. A cantilever at each end permits the bridge to handle repair work at the car dumper or at the skip incline. The bridge has a travel speed of 70 ft. per min. and can be skewed five degrees in either direction. It is completely equipped with safety devices to prevent overtravel of the trolley, and is equipped with magnetic solenoid brakes and rail clamps for provision against high winds.

TABLE II

Furnace Filling

No. of charges	Coke charge	Coke series	Stone actual	Stone theo.	Diff.	Furnace slag	Ore Burden				Total ore	Open hearth slag	Slag volume	Ore to coke	Tons pig	Mn.	Remarks
							Cliffs group	McCook	Sagamore	Tilden							
8	20,000	160,000	....	....	.....	....	.....	.....	....	....	.....	....	....	...	...	...	Total coke blank 360,000 lb.
10	20,000	200,000	2000	....	.....	4000	.....	.....	....	....	.....	....	....	...	...	...	Kindling in tuyeres. Two bushel charcoal in front of each tuyere.
7	20,000	140,000	6700	5996	+704	....	6,000	6,000	1000	1000	14,000	....	2212	.70	3.30	...	OOSCCCCC
7	20,000	140,000	7100	6400	+700	....	7,000	7,000	1000	1000	16,000	....	2035	.80	3.79	...	
7	20,000	140,000	7600	6969	+631	....	7,500	7,500	1500	1500	18,000	....	1985	.90	4.21	...	
7	20,000	140,000	7900	7282	+618	....	8,500	8,500	1500	1500	20,000	....	1849	1.00	4.71	...	Furnace full
7	16,000	112,000	6900	6347	+553	....	7,500	7,500	1500	1500	18,000	....	1803	1.13	4.21	...	OOSCCCC
7	16,000	112,000	7200	6659	+541	....	8,500	8,500	1500	1500	20,000	....	1681	1.25	4.71	...	
7	16,000	112,000	7500	6980	+520	....	9,250	9,250	2000	1500	22,000	....	1610	1.37	5.16	...	
7	16,000	112,000	7000	6489	+511	....	10,250	10,250	2000	1500	24,000	1500	1572	1.50	5.80	1.60	
7	16,000	112,000	7300	6802	+498	....	11,250	11,250	2000	1500	26,000	1500	1512	1.62	6.29	1.70	
7	16,000	112,000	7500	6959	+541	....	11,750	11,750	2000	1500	27,000	1500	1486	1.69	6.54	1.75	
7	16,000	112,000	7400	6854	+546	....	12,000	12,000	2500	1500	28,000	2000	1484	1.75	6.79	1.72	
7	16,000	112,000	7500	7012	+488	....	12,500	12,500	2500	1500	29,000	2000	1452	1.81	7.04	1.67	OOCCOSCC
7	16,000	112,000	7700	7168	+532	....	13,000	13,000	2500	1500	30,000	2000	1433	1.87	7.28	1.63	
7	16,000	112,000	7900	7324	+576	....	13,500	13,500	2500	1500	31,000	2000	1412	1.94	7.53	1.58	
7	16,000	112,000	7700	7220	+480	....	13,750	13,750	3000	1500	32,000	2500	1406	2.00	7.78	1.81	
7	16,000	112,000	7800	7377	+423	....	14,250	14,250	3000	1500	33,000	2500	1381	2.06	8.03	1.77	
7	16,000	112,000	7800	7534	+266	....	14,750	14,750	3000	1500	34,000	2500	1350	2.12	8.28	1.72	
14	16,000	224,000	7800	7690	+110	....	15,250	15,250	3000	1500	35,000	2500	1323	2.19	8.52	1.68	
14	16,000	224,000	7800	7847	— 47	....	15,750	15,750	3000	1500	36,000	2500	1296	2.25	8.77	1.64	
Then	16,000	.....	7400	7035	+365	Scale 2000	17,050	13,100	2850	1000	36,000	2800	1224	2.25	8.99	1.61	

TABLE III

Analyses of Iron from Blow-in

Cast No.	Time	Date	Sil.	Sul.	Phos.	Mn.	Tonnage
1	2:30 A.M.	11-5	4.05	.070	.204	.90	42
2	6:27 A.M.	11-5	3.85	.037	.256	.74	92
3	12:28 P.M.	11-5	3.48	.039	.224	.80	67
4	5:12 P.M.	11-5	3.32	.023	.200	.92	70
5	2:00 A.M.	11-6	2.92	.042	.200	1.04	103
6	6:00 A.M.	11-6	2.44	.047	.232	1.16	87
7	10:00 A.M.	11-6	2.48	.037	.248	1.58	111

Storage bins are aligned along the one side of stock yard. They consist of nine pockets, each of 3120 cu. ft. capacity, and nine of 2900 cu. ft. each, in addition to a large central compartment for coke. A 50 ton capacity side dump electric transfer car runs along the double track on the top of the storage bins. Limestone is unloaded from railroad cars on these same tracks directly into the storage bins.

Scale cars in the stock house are of the double compartment type, each compartment having a capacity for 18,000 lb. of ore.

Ore chutes to the skip cars were changed to provide a steeper chute. The existing coke bins were altered and the old grizzly screens discarded. Two new 5 ft. 0 in. x 8 ft. 6 in. shaker screens were installed, each feeding into a 200 cu. ft. weighing hopper equipped with a 10,000 lb. dial indicating scale. The layout thus follows the modern trend of screening the coke into a weighing hopper rather than directly into the skip cars. On the outlets from the central coke bin to the vibrating screens are placed manually adjusted gates, by means of which the rate of coke feed is set. Magnetically operated mercury switches located on the dial indicators of the scales determine when full weight and zero weight are reached on the scales, starting and stopping the screen motors as required. The weigh hoppers are provided with steam operated gates governed by solenoid operated valves.

Coke may be measured in the weigh hoppers either by weight, using the scales, or by volume. Volume measurement is made through the use of electrodes suspended over and dipping into the hopper to the desired level (or coke volume) to which the hopper is to be filled. When the required level is reached, coke touches the electrodes and shuts down the coke screen.

The coke handling equipment is entirely under automatic control, and is interlocked into the general charging equipment. The sequence of the charging round may be pre-determined and the control pre-set to meet this sequence. Coke is then automatically charged from the weigh hopper into the pre-determined skips in the charging round during which time the scale car gates are automatically locked shut, eliminating the possibility of mistake on the part of the scale car operator. The weigh hoppers are automatically filled with coke to the pre-set weight or pre-set volume, and skip loads of coke are automatically counted on a register as they are charged into the furnace. The skip must be in the pit and the full measure of coke in the weigh hopper before the hopper gate can be opened. The hopper gate must be closed and the skip out of the pit before screens can start refilling the weigh hopper. Should the scales fail to ascertain full weight, an emergency shut-off stops the screens to prevent a coke spill. Anything less than full measure in the weigh hopper will hold up charging operations from that hopper until full measure is again obtained. When the pre-determined charging sequence calls for ore or stone, coke cannot be dumped into the skip.

The control panels shown in Figure 2 provide the complete control for all furnace charging equipment except the scale car and the skip, and also provides interlocking with both of these units. On this panel are mounted three motor-driven cam type program switches, the first of which controls the operation of the small bell, the second counts the dumps of the small bell, and

FIGURE 6—Indicating and recording instruments are provided in a modern control house on the cast house floor.

ADVERTISING PAGES REMOVED

the third controls the operation of the large bell. The connections between these program switches and the interlocking switches placed on the controlled equipment are such as to give forced sequencing and forced interlocking of the operations of the skip, revolving distributor, small bell, large bell, and stockline recorders. Only the pre-set program of operations can be executed. Each piece of charging equipment must go through its operation before subsequent operations can be initiated. Selector switches are provided for pre-setting the number of dumps of the small bell before a dump of the large bell. The distributor control is much simpler than former systems, many dial faceplates, selector switches, and skip counting devices having been eliminated. The hopper limit switch previously used at the furnace top has also been eliminated.

This is the first control built in which all of the controls for bell operations, stockline recorder, revolving distributor and coke weighing were built into one panel.

Located in the stockhouse at the foot of the skip incline is a signal and push-button panel (shown in Figure 5) on which are mounted a top pressure indicator, a blast pressure indicator, and a stockline recorder, together with signal lights for indicating the bell movements, position of bells, stock level, distributor position, skip position, and condition of weigh hopper filling. The center push button at the bottom of the panel is used for starting the skip for loads other than coke. The remaining push-buttons are for emergency manual control of the bells and coke handling equipment in case it is necessary or desired to swing over to manual control.

Thus, the problem of charging the furnace has been simplified, and rendered automatic. The scale car operator's duties are confined to filling the scale car with the required quantity of ore or limestone and dumping them into the skip. After loading the skip with these materials, a push-button sets the equipment into motion. The scale car operator is given considerably more information about the operation of the furnace than in previous systems.

Four uptakes are provided on the furnace, each 6 ft. 1½ in. in diameter and extending vertically 27 ft. above the top platform. These uptakes are connected to two 7 ft. 8 in. downcomers. None of the uptakes or downcomer system is brick lined, thus affording a maximum of flow area. Offtakes and all elbows are lined at the wearing zones with .60-.70 per cent carbon steel plate, ½ in. thick, bolted to the pipe. This construction allows a considerable drop in gas temperature, giving lower gas velocities. Gas velocity in the downcomers will be about 25 ft. per sec. at full operating rate. Two bleeder valves are provided on diagonally opposite uptakes.

The two downcomers radially enter a 22 ft. x 40 ft. primary dustcatcher. Gas then passes to a 12 ft. 6 in. tangential whirler, and on to a 15 ft. x 64 ft. tower washer. Gas for the stoves then passes through a 40,000 cu. ft. per min. disintegrator, while gas flows to the boilers direct from the tower washer. Dust content of gas leaving the disintegrator is under .02 grains per cu. ft.

Blast is furnished to the furnace from two turboblowers, one of 45,000 cu. ft. per min. capacity and one of 75,000 cu. ft. per min. at 30 lb. gauge. The latter machine has been completely rebladed and overhauled, and develops the rated capacity at 2900 rpm., requiring 8530 brake hp. at the coupling and consuming 80,000 lb. of steam per hr.

Steam is provided from a boiler house containing five 800 hp. bent tube four pass boilers built for 230 lb. pressure, 125 degrees F. superheat. The boilers are fired with blast furnace gas through four pressure burners placed under the mud drum at the rear of the setting, and have provision for auxiliary coal firing on shaking grates.

Blast is heated in four 22 ft. x 100 ft. two pass side combusion stoves totaling a heating surface of 380,000 sq. ft., which is felt to be sufficient for the new furnace. Checker brick is 2 in. and 2½ in. in thickness, and checker flues are 3½ in. square. The stoves are equipped with burners of the pressure type.

The cast house is about 95 ft. wide, and is served by a 25 ton crane with a 5 ton auxiliary hoist. This crane also spans two railroad tracks, one of which is the hot metal track. Iron runners are laid out to deliver iron to four 125 ton mixer type ladles, in which the iron is conveyed to the open hearth plant. Slag is normally cast alternately into two slag pits, from which it is removed by an electric shovel. The tapping hole and the cinder notch are spaced 45 degrees apart.

The furnace operating floor is paved with vitrified brick. Convenient to the furnace is a tile-lined control room, 12 ft. square, containing a stainless steel instrument panel upon which are mounted indicating and recording pressure and temperature instruments, a stockline recorder, and a stock movement indicator which shows accurately the movement of the stock column. Here are also placed the snort valve control wheel and the controls for the electric mud gun which is suspended from a furnace column.

Details of the filling and blowing in of the furnace are set forth in the accompanying tables. Preliminary operating results indicate that the changes in lines have been of material benefit, and point to a highly successful campaign. Production is averaging about 1000 tons per day, using a blast volume of 75,000 cu. ft. per min. and a blast temperature of 1000-1200 degrees F. Coke and limestone consumptions average 1891 and 836 lb., respectively, per ton of iron. Blast pressures average about 23 lb. per sq. in., and the furnace is making 196 lb. of flue dust per ton of iron produced. Iron normally contains 1.16 per cent Si, .020 per cent S, .382 per cent P, and 1.65 per cent Mn. Slag analyses are somewhat as given below:

Si O	34.56 per cent
Al_2O_3	12.70 per cent
Ca O	42.4 per cent
Mg O	7.01 per cent
S	1.54 per cent

Gas analyses show 14.2 per cent CO_2, 25.4 per cent CO, and 4.0 per cent H_2.

PROGRESS of LUBRICATION in the Steel Mill

By C. C. PECU, *Lubrication Engineer*

BETHLEHEM STEEL COMPANY

LACKAWANNA, N. Y.

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▲ DURING my time as lubrication engineer, there has been great progress made in steel plant lubrication, especially during the past few years. To bring the subject out into the light, let us think back years before the world war. We remember the massive steam engines, mostly grease lubricated, the streams of water more or less used on the crank pins and journal bearings, and the day of repairs, Sunday, when each cylinder was inspected and when men were at work repairing the engine bearings so that they might operate during the coming week.

We remember the open pinion housings; the pinion teeth, lubricated with pitch, and a stream of water flowing on them to keep them cool, so that the pitch would better adhere to them. Also, the pinion bearings were lubricated with suet or grease, and always a stream of water on the necks. If the pinion life was over four years and the bearing life over one year, it was considered good.

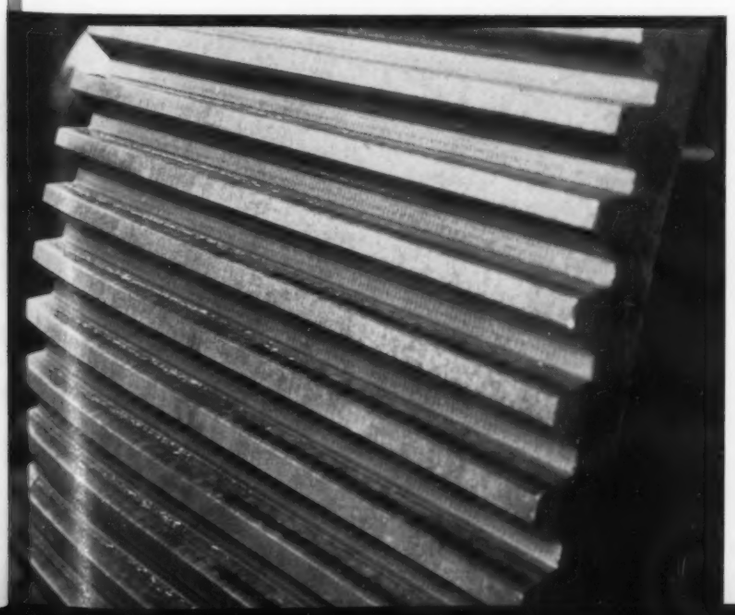
We remember the roll necks being lubricated with suet or hard grease, which was useless unless the neck became warm enough to flow the fat and oils; also, when it was a constant effort to keep a good section due to bearing wear; and the large number of roll neck bearings changed each month.

We remember the mill tables with the open top bearing, which must be lubricated with an oil can, the cap of the bearing trapping roll scale and dust, and the constant replacing of bearings due to the contamination of the lubricant with this abrasive material, and the exposed table gears which were swabbed by hand.

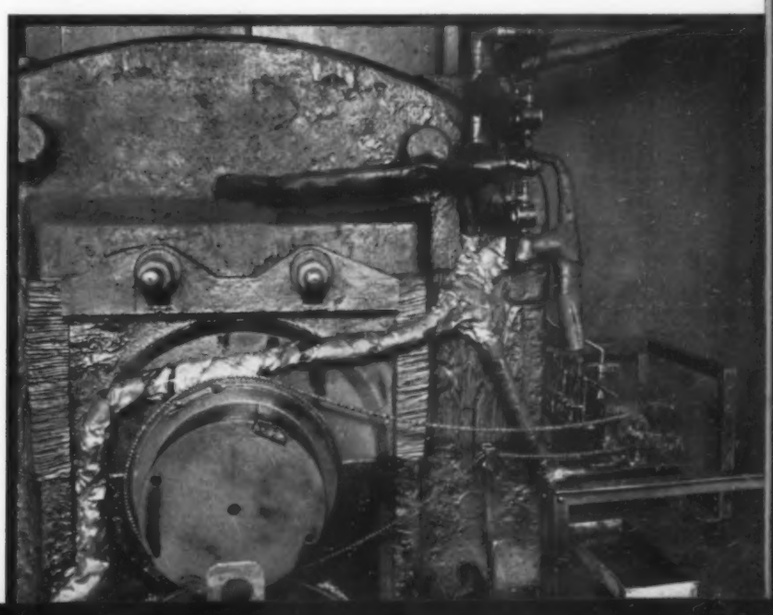
This is not a dream, as some of these mills are in operation today, but improved by modern ideas, modern lubricants and modern lubricating apparatus.

About 1910, far-sighted engineers began to improve the lubrication of machinery. The lost time of mill operation, the excessive number of man hours required to keep the machinery in operation, and the great power

An example of pitting which occurred before the use of extreme pressure lubricant, and which was stopped by the application of this lubricant.



View showing installation of force feed pump for lubrication of pinion bearings on a 36 in. blooming mill.



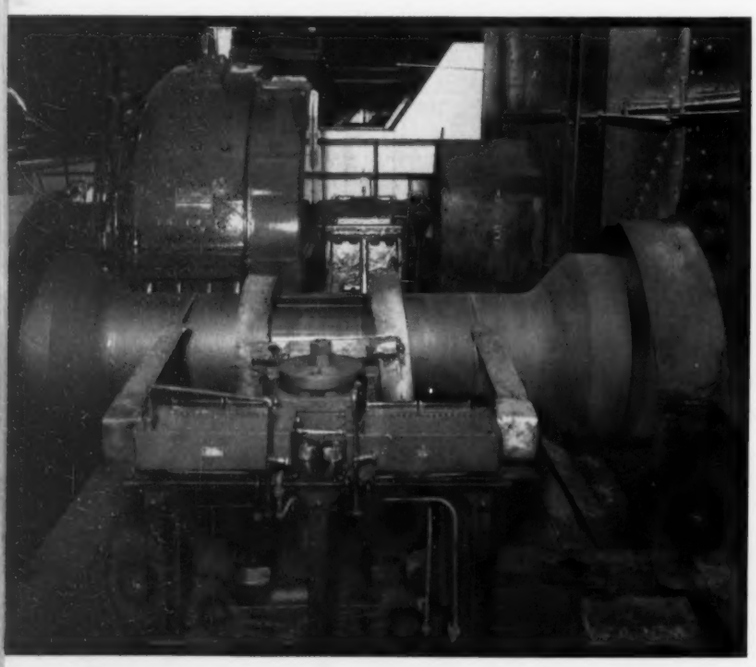
loss due to friction were not to be tolerated. Consequently, a campaign was started. It was not completed over-night, it took years to accomplish the objective. During this time, the engineer had in mind what he wished to accomplish, but the best way must be found by trial. Finally, the best way for each plant to follow was decided upon and the campaign started.

The first was to decide on the best type of an oil filter. Many were on the market with a bath of water, a layer of excelsior or waste, and bags for final cleaning. Later, all this was done away with and gravity allowed to do its work.

Then followed the enclosure of all moving parts of the engine and the installation of continuous oiling systems. Next came enclosing pinion housings, allowing a bath of lubricant to be used and mechanical oilers applied to pinion necks. After this, experimenting with different types of babbitt and bronze grids to be used in roll neck bearings; different ways of lubricating the roll necks.

At first grease cups were attached to each bar mill bearing. This helped to a certain extent. The top bearings were the most difficult to lubricate. Something must be done to get the grease to the neck; to do this the top bearings of bar mills were redesigned. The bearing was made heavier to allow a grease pocket with a slot direct to the neck, and a soft grease was used. To do this, the breaker block was reduced in size to allow for the travel of the screw. This design has been in continual operation on several mills for many years. On the bottom necks a light iron grease retainer was used. The grease packed in the retainer so that the weight of grease and retainer rested against the neck. The iron retainer acted as a partial scale guard. These different ideas proved to be a great help on bar mills.

Two force feed pumps supply lubrication to the bearings of the 48 in. and 36 in. mill pinions.



C. C. PECU

On the larger necks another idea was used. At first a wooden (later cast-aluminum) box was made with a partition in it; one part was filled with hard grease, the other part was a receptacle to hold soft grease which was forced into the box by a specially made large grease cup. The soft grease was forced onto the necks and the hard grease in the lower section spread the soft grease evenly and resisted the pressure of the water to flow the grease away. Several of these boxes are still used in connection with a modern grease pump. These ideas were the forerunner of the modern grease pumps.

Finally, and very important, the type of lubricant used on roll necks was changed. It took some time to prove to the grease manufacturers that we wanted a grease that would not disintegrate under water and at the same time would lubricate the neck. When this was accomplished, better results were obtained. The time between lining up the mill was increased many times, the section was more perfect, and the power saving was great. It was found that the change in several mills reduced the friction load on engines up to 90 hp. and the total mill load 500 to 800 hp. These figures are actual, not guess-work.

Today, we see a streamline mill, as it were. The designer has enclosed every possible moving part. Automatic oiling and greasing devices are used everywhere. The air is washed in many motor rooms. The fluid lubricants are elaborately filtered, and the lubricants frequently analyzed to see that they are in proper condition. During the last few years, steel mill lubrication has improved rapidly, otherwise our modern mills would not function efficiently.

While lubricants have improved to a certain extent, the modern design of machinery and the modern appliances used to carry the lubricant to the bearings have been, to my mind, the great factor in the advancement

of steel mill lubrication. I do not mean to belittle the advancement made in lubricants, but as to oils for mill use, except for better refining so that they will resist emulsions and form a more even viscosity index, I cannot see much change. On the other hand, the improvement in greases has been great. It was not so many years back that the so-called yellow cup greases and hard roll neck greases were about all the greases in use, but with the advent of ball and roller bearings, the greases with a high soap content had to be changed. Today, to meet the varied conditions, we have greases with a low soap content and high viscosity oils; greases with an extreme pressure content to increase the film strength of the lubricant; greases with different soap bases, the better to suit the many requirements; greases for high and low temperatures, and to resist water contamination conditions; greases that will not bleed or readily disintegrate, which causes dripping and tends to poor housekeeping.

The roll neck greases have improved greatly. The very hard dry grease, which would break like bread, which would disintegrate and float away, which was so heavy with soap that it required much heat to soften it so that it would adhere to the neck, today is replaced with a more plastic grease, some with a graphite content for plain bearings.

The design of roll neck bearings has changed. Early in mill practice, solid bronze and babbitt with bronze inserts were used. Even today, these types must be relied upon in all instances as the last resort. Around 1915, lignum vitae wood came into use, with more or less success, depending on the origin of the wood. If the wood were grown in a hot moist atmosphere, it had a heavy sap layer and consequently was soft, but if grown in a hot high altitude climate, the sap wood was thin and the wood dense and hard. Wherever wood could be used, it was a great success. The tonnage was increased over metal bearings many times and the power consumption was very low. Then came the synthetic resinous bearings. They have succeeded beyond expectation. The only requirements are that the journal must be a polished surface, the bearing must fit the journal and the water must be free from grit. It is said that these bearings do not require any grease lubrication, only water being required; but on slow speeds, grease does help. The high speed necks are able, by their rotation, to trap a water film and do not need a grease film.

Then came the high speed strip mills which required bearings to withstand the great pressures developed in the rolling operation. The ordinary plain babbitt bearings with brass grids were used, but for accurate work, the roller and babbitt oil flooded bearings have been adopted. The roller bearing makers recommend an extreme pressure lubricant, but some operators claim it is not necessary. However, we know that while the bearing is supposed to have only a rolling action, there must be times when a slight scuffing action must occur, and if so, an extreme pressure lubricant will protect the surfaces much better than a plain grease. With this thought in mind and knowing that an extreme pressure lubricant has a stronger film strength, it must be a good insurance against rapid wear of the bearing parts to use it.

The roller bearing has been superseded in many mills on backing-up rolls by the solid babbitt controlled oil flood bearing which has proved a success. It relies on the high viscosity of the oil developing an hydraulic pumping action by the rotation of neck in the bearing, making for an unbroken film of oil.

The mill pinions have, up to a few years back, been a heavy expense to all mills. The open type housing required that all pinion teeth be swabbed. That, at its best, provides poor lubrication because it requires constant manual attention which if not properly given will result in the teeth running dry. Also, the bearings wear so rapidly that the teeth are on the pitch line only after lining them up when starting. Consequently, pinion teeth wear raipdly. Today, the enclosed bath and automatic lubrication of both teeth and necks have proved so satisfactory that they are about the least trouble of mill machinery.

There is some question as to proper lubricants to be used on mill pinions. It all depends on the speed of the mill and the metal in the tooth. There is no question

View of 40 in. mill pinions after rolling 5¼ million tons of ingots. The bearings were not changed during this time.

but that a slow speed large tooth pinion requires a much heavier lubricant than does a higher speed pinion, especially if the carbon is low and the metal has not been treated. The modern manner of lubricating pinion teeth with a flood of oil is superior to the old way of a bath, providing the proper viscosity of oil is used. The present success is due, in a great measure, to the teeth running on the proper pitch line, due to practically no bearing wear after years of service.

Blooming mill screws and nuts, years back, were a constant source of trouble due to the neglect of protecting these vital parts against iron oxide, and to the hit or miss style of lubrication, but today with an entirely enclosed housing with boots on the screws and automatic lubrication of all the parts, three million tons service on the structural section bloomers should be a fair tonnage. However, bloomers rolling slabs is another question, due to the long run of the screws; here 1¼ million tons should be a low tonnage run.

Today, with section tolerances much closer, the lubricant must be at its best. We cannot condemn the lubricant if we permit it to be contaminated with water and dust. The lubricant cannot properly function if the journal and bearing surfaces are not in the best condition. It seems to be the idea that anything will go in a steel plant. It goes, but in just the proportion to the effort we put into it. Poor fits and surfaces mean a short life; proper fit and surface, a long life. In other words, we get out of machinery just as much as the attention we give in designing it and the care we give to it when in operation.

The lubrication of a steel plant is a very simple matter in this day and age. This may appear to be a very broad statement, but it is not. If we know the machinery we expect to operate, all that is needed is the proper lubricant to use. If we do not know the lubricant, with the steel industry lubricated to the extreme as it is at the present time, it does not take much time to obtain the information required.

When we look back over many years and see the change for efficiency and economy which has taken place, it is almost unbelievable. At one time the shops were rushed boring new bearings. The babbitt foundry employed many men babbitting bearings. The spare table line shaft gears were always in the shop for repairs. The mills worked overtime on repairs. Much mill time was lost due to lining up mill bearings. The question of proper section tolerances was before us; the short life of mill pinions and mill screw-down screws and nuts; and large quantity of lubricants used with only fair success. We can now see the reverse of all this, due in a great measure, in the older mills, to the efficient mechanical calibre of the mechanical superintendent and his associates. Here he has adopted modern methods of applying the lubricant and protecting it from contamination with abrasives. And to these men we can give credit for all the advancement made on older mills —and more, their developments have given the machine designer the ideas by which he can perfect the design of future mills. The operator must make the mill run, he has to overcome all obstacles, his mill must run continuously and at a minimum cost—so to him we can give much credit to the advanced lubrication of today.

But the modern mill, with all the improved design of machinery, improved lubricants and improved appliances for lubricating the machinery, needs only to be kept in a good condition to gain the best results.

Machinery must wear, some more than others, but in a mill when a cobble occurs and the stress developed is so great that the circuit breaker is blown out, when the rolls break causing a heavy end thrust, and many other forms of overloading develop, lubrication cannot be blamed for scuffing of bearings or pitting of pinion teeth.

As to the future, who can tell? Improvements must come as time goes on, but even with the present types of lubricants, all that is needed is to better design the bearing so as to keep out abrasive matter and water. And, if possible, better develop the structure of steel for use in reduction gears and mill pinions.

Mechanical lubricating devices should be attached to every piece of machinery where practical. For both oil and greases, there are many different ways of obtaining the same results which are giving excellent work.

While the filtering devices for oil are the best ever, with large settling tanks and a battery of centrifuges, there is one more step that can and should be taken, especially where the oil is contaminated with water—that is to add the vacuum process to dehydrate the oil. We admit that the centrifuge is doing good work, but it also churns the oil to a certain extent, which, together with the heat, assists in oxidizing the oil. With the vacuum process, the centrifuge would be needed only to take out the abrasive matter, and would be in use only for a short time each day. Through the centrifuge, if sludge is ejected, there is a loss of oil, which is next to impossible to separate from the sludge. The vacuum process is an added expense, but it is by far the most economical in the long run, and leaves the oil in its original state.

The importance of the best possible lubrication of machinery has prompted many companies to appoint lubrication engineers. There is a large field for such men. They should be mechanically minded so as to easily diagnose the subject; they should have the mind of a genius so as to easily form ideas to apply the lubricant; and above all, they must be diplomats, because they must learn to give and take, remembering that they must sell themselves to their fellow workmen. After this is done, it will be easy to perform their duties.

During my time, great strides forward have been made, so during the years to come there will be many improvements not only in lubrication apparatus, but also in improving the quality of lubricants.

Whatever success we have had at our plant, has been through the proper application of the lubricants noted in the following pages. We are using several types of force feed grease pumps, oil pumps and filters, all of which have been a success.

If there is any question as to the type of lubricants to use on steel mill machinery, the answer can be found in the following data. All that is needed is its proper application.

LUBRICATION SPECIFICATIONS

Reciprocating engines with flood lubrication	160 sec. vis. oil @ 100° F., 26 Baumé gravity pour plus 16° F.
With oil cups	250 sec. vis. oil @ 100° F., 23-26 Baumé gravity pour minus 6° F.
Engine cylinders:	
Saturated steam	145 sec. vis. oil @ 210° F., 25 Baumé gravity compounded with 7 per cent acidless tallow.
Superheat steam	160 sec. vis. oil @ 210° F., bright stock compounded with oxidized paraffin compound.
Air cylinders:	
100 lb. and lower pressure	160 sec. vis. oil @ 100° F., 26 Baumé gravity pour plus 16° F.
120 lb. and higher	300 sec. vis. oil @ 100° F., 24.8 Baumé gravity pour plus 16° F.
Gas blowing engine motor cylinders	140 sec. vis. oil @ 210° F., 25.8 Baumé gravity compounded with oxidized paraffin compound.
Steam turbines:	
Flood lubrication 170° F. and lower	160 sec. vis. oil @ 100° F., 26 Baumé gravity pour plus 16° F.
Ring oiled 140° to 175°	500 sec. vis. oil @ 100° F., 28.6 Baumé gravity pour plus 18° F.
175° to 210° F	975 sec. vis. oil @ 100° F., 28.6 Baumé gravity pour plus 20° F.
Motors and motor-generator sets with continuous oiling system	160 sec. vis. oil @ 100° F., 26 Baumé gravity pour plus 16° F.
Motors, ring oiled:	
Normal temperature	160 sec. vis. oil @ 100° F., 26 Baumé gravity pour plus 16° F.
Temperature 125° to 150° F	300 sec. vis. oil @ 100° F., 24.8 Baumé gravity pour plus 20° F.
Temperature zero	140 sec. vis. oil @ 100° F., 24.5 Baumé gravity pour minus 12° F.
Motors, roller bearings:	
Grease lubricated	Penetration point 385 worked. With 220 sec. vis. oil @ 100° F., pour test 6° F., lime soap or soda soap base.
Temperature 130° F. to 160°F	Penetration point 320 worked. 350 sec. vis. oil @ 100° F., pour test 20° F., soda soap base.
Motor-generator sets	
3000 to 3600 rpm., ring oiled	160 sec. vis. oil @ 100° F., 29.4 Baumé gravity pour plus 24° F., best of turbine oils.
Large mill pinions:	
With bath	Soda base transmission grease. With low vis., medium flash and fire. Test oil with 6% synthetic graphite. 215 to 230 penetration point, or 5,000 sec. vis. asphalt pitch @ 100° F. Cut back to 3,000 sec. vis. @ 100° F., with 150 sec. vis. steam refined cylinder oil at 210° F.
Small, high and medium speed	Same stock as above, cut back with oil to a less viscous body according to size and speed of pinions.
With oiling system, slow speed	2800 sec. vis. oil @ 100° F., 25.7 Baumé gravity pour plus 35° F.
Medium speed	28 in., 30 in., 32 in. and 35 in. mills—2400 sec. vis. oil @ 100° F.; 14 in., 16 in. and 24 in. mills—1800 sec. vis. oil @ 100° F.; 8 in., 10 in. and 12 in. mills—1250 sec. vis. oil @ 100° F.
Mill reduction gears with bath	Soda base transmission grease, 320 penetration point with 7% synthetic graphite, high viscosity oil.
With oiling system	1750 sec. vis. oil @ 100° F. for severe high speed work. For less work down to as low as 900 sec. vis. @ 100° F. Viscosity according to speed and work.
Roll necks, hand packed	Hard lime soap base grease. High tallow content, high viscosity and flash oil with 7% synthetic graphite. Penetration point 56 unworked.
Pressure systems	Lime base grease, high viscosity and flash oil with 6% synthetic graphite. Penetration point 220 unworked.
Roller bearings	Lime soap grease. High flash, high viscosity oil with an extreme pressure content. Penetration point 250 unworked.
Screwdown screws and nuts on ordinary bloomers	Steam refined cylinder oil, 180 sec. vis. at 210° F., 21.5 Baumé gravity, with automatic pumps.
Slab bloomers	200 sec. vis. @ 210° F., 24.5 Baumé gravity. 6% acidless tallow. All screws and nuts to be lubricated with an automatic pump.
Screws and nuts, strip mills:	
Winter months	For hot strip—3,000 sec. vis. @ 100° F., extreme pressure. Lead base grease.
Summer months	4200 sec. vis. @ 1000° F. Extreme pressure lead base grease.

Worm gears:	
Normal work	Cylinder oil 143 sec. vis. @ 210° F. 24.8 Baumé gravity, compounded with 6% acidless tallow.
Heavy work	185 sec. vis. @ 210° F. 24.4 Baumé gravity, compounded with 6% acidless tallow.
	Also 2700 sec. vis. @ 100° F. Extreme pressure lead base grease.
Worm gears—high speed, light work, warm condition	975 sec. vis. oil @ 100° F., 28.4 Baumé gravity compounded with oxidized paraffin compound.
Mill tables:	
Plain bearings, normal conditions	90 sec. vis. oil @ 210° F., 20.4 Baumé gravity.
Hot condition, slab and heavy structure	180 sec. vis. oil @ 210° F., 21.4 Baumé gravity.
Ring oiled high speed	320 sec. vis. oil @ 100° F., 23 Baumé gravity.
Exposed tables outside mill plain bearings, summer	90 sec. vis. oil @ 210° F., 20.4 Baumé gravity.
Exposed tables, plain bearings, winter	325 sec. vis. oil @ 100° F., 25.6 Baumé gravity minus 6° F. pour. (Special blend for car journals.)
Mill tables, plain and roller bearings, hot condition	Lime soap base grease, with high flash and high viscosity oil. Penetration point 250 unworked.
Plain and roller bearings, cold condition	Lime soap base grease, medium viscosity and flash oil with 8° pour. Penetration point 285 to 375 according to speed.
Mill table gears, hot condition swabbed	5,000 sec. vis. @ 100° F. Asphalt pitch, for different temperature and rpm. increase or lower viscosity.
Gears in bath	2,000 sec. vis. @ 100° F. Asphalt pitch. Also, soda base transmission grease, with 7% synthetic graphite. Penetration point 360 unworked.
Gear bath on single rolls, exposed—winter	Soda base transmission grease. 290 penetration point. Cut back with 250 sec. vis. oil @ 100° F. 23 Baumé gravity minus 8° F. pour test.
Wire rope locomotive cranes, structural yard, stockyard, etc.	Asphalt stock—2,000 sec. vis. @ 100° F. All cables should have a pliable lubricant that will not harden or chip off. The asphalt stock is impervious to all acid fumes and is waterproof. Hot ladle cranes should be coated with a thin stock and often.
Ladle cranes in open hearth, ingot strippers, etc.	Asphalt stock—4,000 sec. vis. @ 100° F.
Blast furnace skip hoist	Asphalt stock—4,000 sec. vis. @ 100° F.
Car haul cables	If cables are protected from dirt, an asphalt pitch is proper, but if contaminated with dust such as iron ore, limestone and surface grit, a much thinner lubricant is preferable. If the cables are slow moving, a heavier lubricant can be used on the surface. It will help to keep out of the cable much fine grit.
Cold water plunger grease	A petrolatum jelly lime soap base grease with 7% synthetic graphite. Penetration point 350.
Car journals, both hot ladle and normal yard work	335 sec. vis. oil @ 100° F., 25.6 Baumé gravity minus 5 pour test.
	Use good wool waste mixed with a long fiber cotton waste. Do not pack too high on sides of journal. Be sure a ring of waste is thrust against the collar of the journal. Do not flood the collar box with oil when packing. See to it that the waste does not drip oil. If so, it will become soggy and drop away from the journal.
	Guard against lint. It will carry up on journal and wedge itself between journal and bearing. This lint will wipe off the oil film on journal.
Oil grooves	Bearings must not be destroyed by poor design of oil grooves. If the oil enters the bearing through the journal, simple, narrow, well chamfered edges of grooves is all that is needed. If the journal is running one way all the time, groove the top of one and bottom of other, thus forming a pocket for distributing oil on the surface of both halves of the bearing.
	If the journal has a reversing motion, the top of both valves should be grooved, only.
	The wrist pin of an engine should have a flattened surface on the top so as to act as a reservoir for oil. If the oil is fed through the bearing strap, it should be carried by a nipple to near the pin surface. If it is fed through the end of pin, the flat will act as a reservoir to distribute the oil evenly throughout its length.
Mill traveling cranes	The type of lubricants used must be several due to the capacity of the crane and the temperature of the atmosphere in which they are situated. The lubricants described in these data will lubricate any crane, equipped with either plain or roller bearings.

DISCUSSION

PRESENTED BY

E. S. GLAUCH, *Lubricant Sales Department*, Joseph Dixon Crucible Company, Jersey City, New Jersey.

MAURICE RESWICK, *Lubrication Engineer*, Standard Oil Company of New Jersey, New York, New York.

E. S. GLAUCH: There is no question but that Mr. Pecu has done a great deal for the steel industry in his many years as lubricating engineer at the Lackawanna Plant in promoting better and improved lubrication of steel mill equipment. Mr. Pecu has pioneered on many features of mill lubrication and the data that he presents in his paper will undoubtedly be a valuable aid to other lubrication engineers, not only in the steel mill field but in other industries as well.

There is one thing, however, that I would like to bring to the attention of those whom Mr. Pecu referred to in his presentation, "the younger lubrication engineers," and that is, the specification section of his paper.

The writer would recommend that the lubrication engineer use this information for his own guidance, but that he does not try to draw up specifications which he in turn would hand to his purchasing department for the purchase of lubricants. I make this statement because in the past I have found that government agencies who are not permitted to purchase materials by trade name do draw up specifications and purchase thereon. The result usually is, that after a short period of time, the lubricant they get is not as efficient as the lubricant that they originally used and upon which the specification was based. This is brought about quite often by some small concern that desires some of the business, cutting prices, and eventually it results in lowering of quality, which in turn effects lubrication.

Mr. Pecu also in some of his specifications refers to graphite and undoubtedly there will be other steel mill lubrication engineers with wide experience that will disagree on the percentage of graphite specified; also, I question the specifications when he refers to synthetic graphite.

Natural lubricating graphite has been used for many years in the production of greases and lubricants and today, natural lubricating graphites of high quality and purity can be obtained for commercial use and they have proven themselves in the industry. I have made many tests in various mills in the past where, using graphite lubricant containing high quality lubricating, natural graphite, excellent results were obtained and power consumption was reduced very materially as compared with the lubricant previously used.

The specification that merely mentions the synthetic graphite without any qualifications as to purity or particle size is rather vague.

The steel mill lubrication engineer, if he is dealing with a reputable concern, can safely leave the matter of graphite in the hands of the concern producing the product. However, the lubricants manufacturer will of course at all times be glad to work with the mill lubrication engineer in order to supply him what he desires.

I know that in the past many engineers and purchasers of lubricants have been under the impression that the natural graphite could not be obtained with low percentage of impurities. This is certainly not the case, for I know, that at the present time, many lubricants manufacturers are using better grades of graphite than they did a few years ago and there have been many thousands of pounds of natural lubricating graphite with a graphitic carbon content of 98 per cent or better used in the production of steel mill lubricants.

MAURICE RESWICK: Lubrication of steel mill equipment is a highly specialized art and science, and the foremost authority in this field is Mr. Pecu, the dean of steel mill lubrication engineers. Today Mr. Pecu is the oldest lubrication engineer in experience but at the same time he is also the youngest in ideas, and his message to us is a source of inspiration and practical guidance.

I have known Mr. Pecu for the past ten years, ever since I left the field of steel mill lubrication and changed my job from a user to a supplier of lubricants, and I have watched Mr. Pecu through the various stages while he was adapting himself from the old to the new methods. Today in most steel mills there exist old and new type machinery side by side, and while much of the older machinery has been modernized in the method of application of lubricants by means of pressure systems, circulating oiling systems, certain types of equipment, such as mill tables with open bevel gears, are still lubricated the way they were twenty years ago.

We meet today not as representatives of individual steel or oil companies, but as a fraternity having a common aim of lubricating our mills in the most efficient manner. I believe I am free to speak for the entire oil industry that Mr. Pecu, along with all other steel mill lubrication engineers, has cooperated with petroleum industry whole-heartedly to the mutual benefit of both. When the new giant continuous mills were developed, the oil industry met the requirements of the steel mill engineers by developing new types of lubricants in the form of high-demulsibility oils, roller bearing greases, and extreme pressure lubricants.

Mr. Pecu has given us today a valuable guide in the application of lubricants, but like all general rules, they are of necessity subject to amendment and modification to meet local conditions. There is always a slight difference in the operation of even two mills of the same contruction which affects the type of lubricant that should be used for maximum efficiency. Of equal importance is the available supply of lubricants in any geographical area, and what applies to the Pittsburgh and Buffalo areas, may not hold strictly true to the Gary or Birmingham areas. Frequently trade relations limit the sources of supply, and compromises in the type of lubricant used and in its method of application must be made.

Mr. Pecu's paper points out the general principles which are fundamental to efficient lubrication, and leaves us with the advice that personal initiative and common sense are the final determining factors. The oil and steel industry hope that they will continue to be guided by Mr. Pecu's practical advice for years to come.

W. H. BURR

DEVELOPMENTS *in* *The Iron and Steel Industry* DURING *1939*

By W. H. BURR, *Chairman*
A. I. S. E. Development Committee
and Electrical Superintendent
LUKENS STEEL COMPANY
COATESVILLE, PENNSYLVANIA

▲ REPORTS received by the American Iron and Steel Institute from one hundred and fifty companies representing more than 90 per cent of the industry's capacity indicated that approximately $126,000,000.00 would be spent by steel companies during 1939 for new construction and equipment. Certain additional projects were also under consideration if business conditions warranted. Many of these added projects have materialized, and the above mentioned sum has been materially exceeded.

It is generally felt that the major portion of future expenditures will be in projects of rehabilitation and modernization. Technical advances have led the way toward better process control, increased operating

One of the outstanding developments during the past year was the installation of the new 130-oven by-product coke plant at the Great Lakes Steel Corporation.

economies, and improved quality of product; and competition dictates that existing plant equipment must be improved to meet the new requirements.

COKE OVENS AND BLAST FURNACES

Activity in the coke plant field has been limited largely to rehabilitation and improvements in existing plants. Several plants have installed or are planning new equipment in the by-product recovery field. The trend is definitely toward the continuous methods of recovery where possible. Light oil stripping stills, wherein the benzolized wash oil flows over a series of bubble trays and is subjected to exhaust steam, driving off the light oil as a vapor, seem to be favored. The light oil vapors from the top of the still pass through vapor-to-oil heat exchangers to the base of the crude residue separating column, where the vapors are cooled. Water and residue are condensed and decanted in the base of the residue column. The residue flows to the residue stripper, subjected to direct and indirect steam and finally drained to the crude heavy solvent naptha storage tank. The light oil is further fractionated and refined by continuous methods.

Increased business activity has also led to the rehabilitation of coke oven batteries, involving many interesting problems. One of these jobs, described in detail in the IRON AND STEEL ENGINEER for July, 1939, involved the rebuilding of six oven walls completely and the end flues of all other walls in the battery, the replacement of all oven floor liners, rebuilding of checker-work, replacement of buckstays, repair of air boxes and gas guns, etc. The work, which was further complicated by the operation of other units in the plant, called for considerable ingenuity, and operating results of the restored battery attest to the forethought and skill exercised.

Of particular interest is the installation of continuous pyridine recovery plants in connection with four by-product coke plants. These plants are based on a new patented process and have fully proven themselves in actual operation.

The immense reserves of high grade iron ore in the United States have naturally long delayed any serious steps toward the beneficiation of the ore in the greater part of the industry. A recent interest in this subject is plainly discernible, with the southern plants finding increased economy in proper ore sizing and in a proportional mixing of ores to attain a constant chemical analysis.

One southern producer is installing a central ore conditioning and sintering plant at their ore properties, eliminating ore crushing at individual mines. The decision to install this equipment, of sufficient capacity to handle the company's current ore requirements, resulted from extensive research on the question of increasing the efficiency of the ore smelting process.

Ore will be brought to the conditioning plant in railroad cars, passed through a preliminary crusher and conveyed by belts to a second crushing station. Next it will be screened, sampled and sized into three sizes. Coarse and medium sizes will be stored in steel silos while chemical analyses are checked. Fine ores will be taken from the screening station to the sintering plant, there mixed with flue dust from the company's blast furnaces and with coke breeze, and sintered.

Ore will be taken from the different storage silos by proportional feeders according to definite standards of chemical analysis, and transported to the blast furnace plants, where some changes in stocking facilities are to be made.

Another major producer is installing a conditioning

Modernization and rehabilitation of existing facilities was keynoted in 1939. Consistent with this policy was the rebuilding of the Woodward Iron Company's coke plant as shown below.

A complete new 1,000-ton blast furnace and auxiliaries were added to the blast furnace facilities at the Great Lakes Steel Corporation.

plant in the eastern district to treat the magnetite ores of that district. The plant will use a wet magnetic process, with the ore crushed to such a degree that all will pass through a 35 mesh screen. After the magnetic separation, a sintering process will put the material into suitable condition for furnace use. The process will convert the raw ore, running about 35 per cent iron and high in phosphorus, into a sinter containing 65–70 per cent iron, with a low phosphorus content. These rich concentrates form a very desirable furnace charge, giving excellent operating economy.

With a goodly proportion of present day steel production going into flat rolled products, the question of steel surface is of increasing importance. Due to the ill effects of sulphur upon steel surface, every effort is being made to reduce this element throughout the manufacturing process. Sulphur control in pig iron is largely effected by slag-metal reactions within the furnace, but considerable interest is evidenced in ladle desulphurization, using caustic soda or calcium carbide and sodium chloride, following the experience of some of the English plants. These processes, for American practice, concern mainly the occasional off-sulphur cast, as there is an ample supply of low sulphur ores in the United States for a considerable period of time.

The sharp rise in steel activity during the latter part of the year caused many blast furnaces to be blown in, many of which required relining or modernization. Where possible, hearth, bosh and stockline diameters of the older furnaces are being increased, as well as furnace height. This increase in height tends to keep the ratio of furnace volume to areas of hearth and bosh to about the same values, which have been generally held to be most economical. One modernized furnace shows a hearth diameter of 27 ft., a bosh diameter of 30 ft., a stockline of 19 ft. 6 in., and a height of 98 ft. 7 in. from tuyeres to top ring. A daily output of 1400 tons is expected.

Considerable attention has also been given to coke preparation and handling, in an effort to reduce coke breakage. Several plants used a comparatively small coke bin, with a vibrating screen discharging into a small balance bin which in turn discharges into the skip. Throughout the installations, efforts were made to reduce the amount of drop to which the coke is subjected.

Improved radial distribution of the gases within the furnace is receiving more attention, due to its grave effect upon furnace efficiency. This distribution depends upon bell clearance, the amount of straight section above the inwall, the angle of the large bell, speed of drop of the large bell, inwall batter, characteristics of the charge, method of filling, etc.

The heating of the blast for blowing has also come in for its just share of study, and with improved gas cleaning, more efficient stove checker-work is being adopted. One design finding considerable favor uses a $2\frac{1}{2}$ in. brick thickness and a $5\frac{1}{4}$ in. checker opening in which fillers are placed up to within a short distance of the top. Blast temperature is automatically controlled by mixing some cold blast from the blowers with the hot blast from the stoves. Better mixing is obtained by introducing the cold air at the bottom of the hot blast valve drum on each individual stove.

In the majority of cases, modernization jobs on large furnaces have included rather complete charging control systems, with the coke weighed and put into the skip automatically in proper conjunction with ore and stone,

all in accordance with a pre-determined sequence. The coke charging, the scale car, the small bell, the large bell, stockline gauging, and the movement of the distributor are all interlocked so that the operations may occur only in the proper sequence.

An announcement of great interest during the past year involved the air-conditioning of the blast for a southern blast furnace. The installation is being made to eliminate the evil effects of high and varying humidity in the blast. The process employs a spray type de-humidifier, where the air passes through three sets of sprays of refrigerated water. The air is then delivered to the blowing engines. On the first day of operation, air entered the de-humidifier at a temperature of 85 degrees F., and was cooled to a pre-determined base temperature of about 40 degrees F. Heat removed from the air is absorbed by the sprayed water which is pumped through a 10 in. pipe line to a refrigeration plant some 200 ft. from the air intake, where heat is removed from the water which is then re-circulated back through the de-humidifier. The reduction of humidity by dropping the air temperature to a pre-determined dew point offers much in the way of smooth furnace operation and fuel economy, and is of particular value to the southern plants, although the entire industry is closely watching the results of this installation.

Gas cleaning systems have undergone considerable improvement, their design having been fitted into the existing equipment and the local cleanliness requirements on the gas. In some cases, existing primary and intermediate cleaners have been revamped and improved, and an electrical precipitator added to obtain a high degree of cleanliness. A typical precipitator lately installed is built up of a number of units, each consisting of about 235 tubes, 8 in. in diameter by 15 ft. long. Each unit has two separate high tension frames fed by independent power cables, making it possible to use different electrical connections. Power is supplied by two 24.2 kva. high tension transformers giving a terminal flash of 88,000 volts, but terminal to ground voltages of only 44,000 volts as a grounded center tap is used. Rectification is accomplished by the use of a tube on each transformer terminal. The two tubes on each transformer can be either cross-connected to give a full wave direct current at 44,000 volts or used separately, giving half-wave rectification on each pair of power lines to the precipitator. A unit of this type will clean 55,000 cu. ft. per min. of blast furnace gas at standard conditions to a final cleanliness of .025 grains per cu. ft. The precipitator unit may be superimposed upon a primary cleaner.

A pedestal type mounting for the tap-hole clay gun has been developed, wherein the gun is mounted on a pedestal secured to a foundation at the side of the iron trough and separate from the furnace structure. The gun is swung to and from the tapping hole by a motor mounted on the top of the pedestal and operating through a speed reducer and a gear and pinion. The gun is tilted into proper position to hit the tap hole through the action of a lever. The positive gear drive, plus a magnetic brake, furnish adequate clamping action when the gun is in position.

The gun itself is of the same design as that already in service on about 75 blast furnaces, wherein the clay piston, whose rod is a double rack, is driven by an individual motor through a speed reducer. The barrel has a capacity of 9 cu. ft., which is ample to stop any tap hole.

A new slack cable device for blast furnace bell hoists uses a device directly connected to the chain connectors under the hitch plates, and normally held out by tension of the chains which operate the bell mechanism. Slack-

The trend toward open hearth ladles of all-welded design, giving a saving in ladle weight, enabled plants to increase the size of open hearths despite limits of ladle crane capacity.

ening of the tension on the chains operates the device and shuts off the hoisting machine. Separate units are installed for the large bell and the small bell, and provide a greater degree of safety than the older type, which operated from direct contact with the hoisting cables.

Several of the larger companies have been considering the replacement of small hot metal cars and ladles with larger, more economical equipment. The principal question involved is whether it is more economical to use comparatively small (60–75 tons) heat-retaining type ladles which can be taken from the car and handled by crane, or larger heat-retaining type ladles (125 tons or more), which must be dumped in the car and cannot be handled by crane.

OPEN HEARTH AND BESSEMER

Improvements in the quality of various kinds of steel through special heat-treatments and through the use of special alloying or scavenging additions are among the important recent advances in the steel industry. Stainless steel is among the alloys that have been improved along these lines.

The austenitic chromium-nickel stainless steel containing molybdenum has been modified by the addition of columbium, and in some cases by an increase in manganese content, for improved resistance to a combination of various types of corrosion, including intergranular and pit-type corrosion. This type of stainless steel is especially adapted to fabrication by oxy-acetylene or arc welding, and is excellent for high-temperature service, for resistance to certain acids and to sea-water corrosion.

The favorable strength-weight ratio of suitably designed structures fabricated from cold-worked austenitic stainless steel, which has already resulted in the extensive use of this metal in aircraft structures, can be further improved if the steel has been subjected to a newly developed relatively low-temperature heat-treatment. It has been found that high-strength, cold-rolled 18-8 chromium-nickel steels for lightweight structures can be improved in elastic properties by heating the metal to about 400 degrees F. for a definite period, and then air-cooling. This treatment raises the proportional limit and yield stress, and imparts to the cold-worked material the same modulus of elasticity as that of annealed 18-8—namely 28,000,000 to 29,000,000 lb. per sq. in. This treatment does not materially affect the ultimate strength and ductility, and has no adverse effect on the corrosion resistance.

Special deoxidizing and scavenging agents are finding increased use both in rimmed steel and in the finer specialty steels. When silico-manganese is added to rimming steel shortly before tapping, a cleaner, better steel is produced, and its tendency to age-hardening is decreased. In addition, this treatment with silico-manganese permits a reduction in the use of such deoxidizers as might lead to the formation of objectionable inclusions.

The use of low-carbon or medium-carbon ferromanganese in place of standard ferromanganese is an economical way of obtaining a lower carbon content and, there is reason to believe, of reducing the age-hardening characteristics of sheet steel. These lower-carbon ferro-alloys introduce less carbon to the bath than does the standard ferro-alloy, and are of especial value in the production of low-carbon steel. When they are used, oxidation of the bath need not be so severe, the heat can be tapped from 15 to 30 minutes sooner, and the furnace output can be increased. The finished steel will be free from hard manganese-carbide areas, and will have improved cold-working properties.

The zirconium alloys are increasingly used in high-impact steels as deoxidizers and for grain-size control. Added in sufficient amounts, they also will minimize the detrimental effects of both nitrogen and sulphur. An alloy containing 12 to 15 per cent zirconium and 39 to 43 per cent silicon is generally suitable for this purpose. An alloy containing 35 to 40 per cent zirconium and 47 to 52 per cent silicon, and one containing 55 to 60 per cent zirconium, 15 to 20 per cent aluminum, and 10 to 15 per cent silicon also are available and recommended for applications in which it is desired to add the zirconium in a more concentrated form.

The use of lead-bearing steels is expanding and additional producers announced the availability of this type of steel throughout the year. Lead-bearing steels combine all the desirable properties of open hearth steel with the free-cutting properties which permit from 50 to 200 per cent higher machining speeds. The lead content runs .15–.30 per cent, which has a certain lubricating action, and increases cutting tool life from 200 to 300 per cent, without appreciably affecting physical properties of the steel. When properly added to the steel, the lead is uniformly distributed throughout the steel.

While there have been no startling innovations either in the open hearth process or in furnace design, there has been a gradual rationalization in design and a marked trend toward the rehabilitation of older furnaces. Some development has pointed toward the reduction of the time required for charging and melting down, even to the point of charging all of the scrap within a few minutes. There is some debate on the value of this, however, many holding that it is possible to charge a large open hearth furnace too rapidly. The use of auxiliary melting burners in the front wall of the furnace has been brought forth as a possibility in reducing melting time.

A major addition to open hearth capacity during the past year consisted of five 150 ton furnaces of somewhat unusual design. Due to space requirements, overall furnace length was limited to 70 ft. 1 in., necessitating some departures from conventional design in order to obtain the desired capacity. The hearth is 43 ft. long x 16 ft. wide, brick to brick at the foreplate. With a bath line area of 4.15 sq. ft. per ton of capacity, a bath depth of 33 in. is required.

Furnace roof is of 16 in. silica brick, with an 18 in. rib course over each end door, and with a 22½ in. thickness extending out 6 ft. from backwall. Rise of the roof arch is 30 in., and the roof is insulated with 2 in. of vermiculite granules and a 1 in. plaster coating. The furnace binding is all of heavy slab construction. Throat area at the bridge wall is 92 sq. ft., and uptake area totals 83 sq. ft.

Slag pockets are 14 ft. 5 in. wide by 17 ft. 4 in. long, while the regenerators are 24 ft. 9 in. wide by 20 ft. 3 in.

long. The regenerator chambers are of single construction, to eliminate the central dividing wall, and a flat suspended roof is employed. Checkerwork is of a special type with 6 in. openings totaling 26,780 sq. ft., or 178 sq. ft. of checker surface per ton of capacity, and ranges 13 ft. 4 in. to 14 ft. 5 in. in depth.

The bottoms of these furnaces rest on 24 in. I-beams on two heavy concrete piers, and, from bottom to top, consist of 1 in. of insulating concrete, 2½ in. of insulating brick, 15 in. of firebrick, 6 in. of plastic chrome and 18 in. of dead-burnt magnesite at the tap hole.

Another reported bottom construction, designed to reduce the possibility of bottom boils and to lower installation cost, has the brick sub-hearth formed roughly to the lines of the conventional finished bottom, with a drop of 6 in. from ends to taphole and 2 in. from front to back. The hearth consists of 3 in. of insulation, 12½ in. of firebrick cut to the contour of the finished bottom, a 9 in. soldier course of chrome brick, a 9 in. soldier of chrome-magnesite brick, and a 2 in. working hearth of magnesite. This bottom, in a 135 ton furnace, was burned in in less than 103 hours from cold furnace to charge, and has rendered excellent service, affording complete hearth drainage. Material used in burning in the bottom included 26,000 lb. of 86 per cent magnesite and 3,675 lb. of 14 per cent bar mill scale for the bottom, with 26,000 lb. of magnesite for the banks.

A new instrument for rapid and accurate carbon determinations is now available to the steel industry. This instrument, which has been termed the carbanalyzer, is comparable in accuracy with chemical analysis, and in speed with the traditional fracture test. It is a rugged, self-contained unit, well adapted to severe steel plant service. The instrument is calibrated by checking its readings against chemical determinations, resulting in a smooth curve. Readings can be made in a few seconds and the complete operation, including preparation of the sample, requires only three to five minutes.

There is a marked trend toward the use of open hearth ladles of all-welded design, including trunnion construction and reinforcement members. The trunnions proper may be solid steel forgings with a shank extending through the ladle shell, to which it is fully welded. On the outside of the shell, vertical and horizontal ribs are welded to the shank as well as to the shell. The design has been carefully worked out and definitely ties together the shell, the trunnions and the stabilizing rings, which all act together to carry the load. An important result of the new design is a saving in ladle weight of about one-third, which is of particular value in plants desiring to increase the size of their open hearth furnaces, but limited as to ladle crane capacity.

The bessemer process of steel making has recently become a subject of renewed interest. This process is fundamentally efficient, and several companies have carried on research programs in connection with further development of the process. One line of thought is along the idea of an efficient method of melting scrap so that both molten iron and molten scrap may be used in the process. Another development is along the line of better control of the process, an important item being the application of a photoelectric cell to record the intensity of the bessemer flame. These records are calibrated so that performance may be duplicated in subsequent operation.

MILLS

For several years the construction of wide strip mills has held the spotlight of the mill building field, and so rapid has been the development of these mills that a secondary wave of rebuilding is evident in the older mills. Some of these jobs have already been completed, some are in progress, and others are under consideration. The requirements of these mills for bigger and better slabs have further resulted in new installations or rehabilitation of blooming and slabbing mills. In the field of merchant, billet, bar, rod and shape mills, however, little advance has been made except in a few isolated cases. Extreme interest is evident in this field at present, and it seems that intense activity will result if business conditions continue on a sufficiently high level.

Although the past year brought authorization for the construction in Canada of a continuous strip mill to cost about $10,000,000, construction has not yet begun. Only one continuous hot strip mill was put into operation in the United States during 1939. This mill, located in the Chicago district, is a 54 in. hot mill unit, with cold rolling and finishing facilities. The mill follows the general design which has become rather conventionalized for such plants. An unusual feature in the hot mill is the installation of a vertical coiling unit in addition to the two usual horizontal coilers. The vertical coiler is placed in a table running obliquely to the central run-out table. Strip from the last finishing stand is diverted to this oblique table, and guided into a vertical position. A vibrator then imparts a rippling wave to the strip as it passes over the table to the coiler, which handles material 8–44 in. wide, No. 10–20 gauge, in maximum coil weights up to 7000 lbs.

Existing cold mill equipment, consisting of two 4-high reversing units, was augmented by the installation of a 5-stand, 48 in. cold reduction mill with a finishing speed of 2000 ft. per min. and driven by one 1500 hp. motor and four 1750 hp. motors. This indicates the trend towards higher speeds and heavier power in cold reduction mills.

The installation of the strip mill necessitated the replacement of the existing 35 in. blooming mill with a new 2-high 46 in. x 96 in. reversing mill with a 58 in. lift. This mill produces slabs up to 54 in. in width and 12,000 lb. in weight from ingots weighing approximately 25,000 lb. The existing drive, an 8000 hp. motor, was used for the new mill. Ward-Leonard control is provided for the mill auxiliaries.

Open hearth capacity of this plant has also been expanded, and soaking pit enlargement is under consideration.

Another new type of hot strip coiler has been successfully introduced and operated in a southern plant, wherein the coil is wound onto a mandrel in a manner similar to the cold mill reel. The mandrel is driven by a motor which, together with the motor driving the deflector pinch rolls, receives power from a variable voltage generator. Compensation for the increasing diameter of coil and consequent decreasing of mandrel rpm. for a given lineal strip speed is accomplished by a special combination of rheostats and load relays.

One of the pioneer wide strip mills was re-vamped and

This 35 in., 2-high blooming mill complete with double manipulator, front and rear tables, was installed in conjunction with a new structural mill that was placed in operation during the year.

brought into substantial agreement with the conventional hot mill layout, although possessing several unusual features. This mill is designed for the use of hot slabs from the slabbing mill, heating furnace facilities being adequate only for slightly increasing the slab temperature. This mill takes a full slab length, as no broadside rolling is performed in the strip mill in spite of its 80 in. width, slabs being available up to the maximum width from the slabbing mill. This mill also employs a unique design of hot coiler, an up-coiling type of simple but very effective design.

In connection with this project, a new reversing slabbing mill employing several unusual features was also installed. This mill was designed to produce slabs up to 76 in. wide from ingots of a maximum width of 63 in. This means that it is necessary to spread the ingot width by broadside rolling. The mill consists of a 45 in. reversing stand, with a roll body length of 120 in., each roll driven by a 5000 hp. 0–40–80 rpm. d-c. motor. For broadsiding, the ingot is turned through 90 degrees by an ingenious combination of table roller design and drive on both sides of the mill. Every table roller is of tapered design, with the taper in opposite directions between adjacent rolls. Furthermore, there are two separate table roller drives, with every other roller driven from the same drive. The drives may be operated in the same direction or in opposite directions. Thus, the combination of tapered roller bodies and opposite directions of rotation accomplishes the turning movement simply and effectively.

A vertical roll stand is placed on the exit side of the mill about 30 ft. distant and is driven by a 2000 hp., 0–100–200 rpm. reversing motor. Due to the distance between the stands, synchronization is not necessary except on the last few passes, which are usually light reductions. As all edging is done in the vertical roll stand, a high speed screwdown is not necessary on the horizontal roll stand.

A marked advantage afforded by this mill is the ability to supply full length 16 ft. slabs of the required width to the strip mill, rather than the "half-length" slabs necessitated by broadside rolling in the strip mill. This makes larger coils available from the strip mill.

Another feature of this installation is the use of a flame scarfing machine, which conditions the hot slab surface as it passes from this mill to the strip mill reheating furnaces. This unit satisfactorily removes defects from both sides of the slab, allowing hot charging into the reheating furnaces.

A new structural mill, capable of producing 50,000 tons of finished steel per month, was placed in operation during the past year. This mill supplants previous structural facilities in the plant, and gives a very wide range of structural products. Newly added equipment includes a reheating furnace, a 35 in. reversing breakdown mill, a three-stand train of combination 23 and 29 in. mills, together with hot beds and auxiliary equipment.

Reheating facilities at present consist of a single triple-fired continuous furnace, with provisions for the addition of two more. The mill may be fed with blooms from an existing 40 in. blooming mill through the reheating furnace, or in emergencies, with ingots directly from the soaking pits. The 35 in. breakdown unit is a 2-high reversing mill with counter weighted top roll balance, driven by a 4000 hp., 0–50–100 rpm. d-c. motor. Composition bearings, water lubricated, are used.

The structural mill proper consists of three 2-high stands in a line, side by side. The drives for these stands are a 3000 hp., 70–140 rpm. motor on the one end of the train, and a 2250 hp., 65–130 rpm. motor on the other end. When rolling light product, all three stands may be driven from the 3000 hp. motor. On heavier sections, the first and second stands may be driven by the 3000 hp. motor, while the finishing stand is driven by the

2250 hp. motor. With very heavy rolling, all three stands may be coupled together with the two motors, which are then synchronized electrically to maintain proper loads and speeds. The entire structural stands are changed when a roll change is required, materially reducing roll changing time. Two sizes of stands are provided, 23 in. and 29 in., to be used according to the product rolled. A universal stand may be used as a finisher when needed.

Finished sections are carried on roller tables to a hot saw, on to the hot bed, and through the straightening equipment.

Expansion of pipe capacity has proceeded with the installation of several butt-weld units of the Fretz-Moon type. This type of equipment has rapidly risen in favor within the last two years, and the activity has resulted in some refinement of the construction of the equipment used in the process. These mills usually have a range of product size from ½ in. to 3 in. diameter, in lengths up to 45 ft.

A goodly number of cold strip mills were installed in various plants throughout the country, both in integrated producing plants and in non-integrated finishing plants. A common characteristic of the new mills is the tendency toward heavier construction, heavier drive power, and higher speeds.

PROCESSING AND FINISHING EQUIPMENT

Almost all completely integrated producers have carried on expansion programs to a greater or less degree in the field of finishing and fabricating work. One southern plant, in addition to increasing its basic capacity, has installed new sheet pickling and galvanizing equipment, a bolt and nut plant to produce a complete line of building, carriage and machine bolts from 3/16 in. to 1½ in., a wire mesh department including two large automatic welding machines, patented roofing machines, and other similar fabricating equipment. Another producer in the same district has installed the machinery required for quantity production of cold formed steel sections for prefabricated building units. This equipment includes facilities for forming, welding, assembling, painting and drying.

An improved process for manufacturing cement-lined steel pipe has been perfected. Special formulae are used in lining the pipe, according to the specific application. A measured quantity of special mix is placed in the pipe and forced against the walls by a process which simultaneously removes a high percentage of the water. The combination of special mixture and the process of application produces a greatly improved lining.

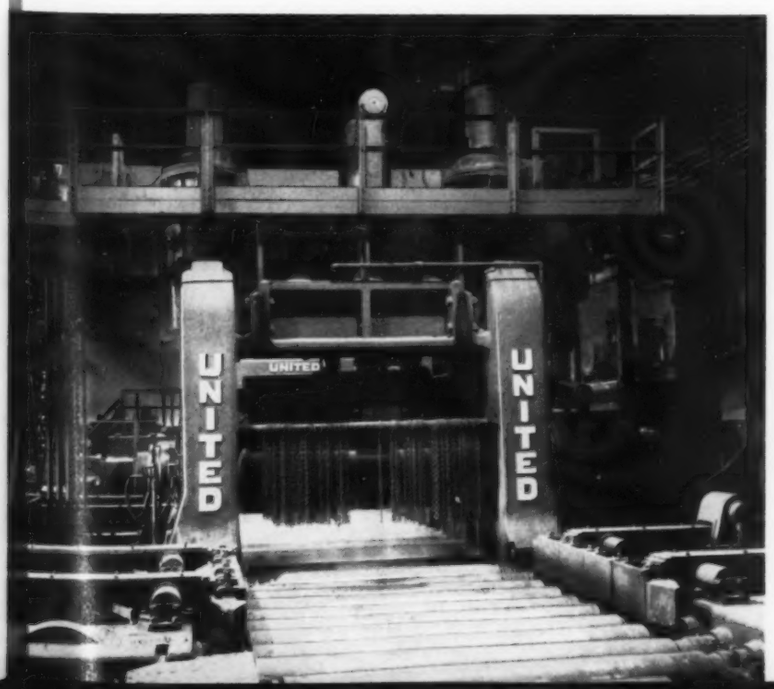
In the strip field, the equipment required by various finishing processes is still in the development stage.

Shearing lines move to higher speeds, tinplate cut-up lines now operating at speeds close to 800 ft. per min., while maintaining an accuracy of plus or minus 1/64 in. An adjustable variable crank motion has been applied to drive the rotary synchronized drums of the shear. In lines using the up-cut shear instead of a flying shear, the production of the line depends considerably on the speed of the shear itself, and in order to get very rapid action, several recent installations have employed special low inertia high torque squirrel cage motors, cooled by auxiliary internal blowers.

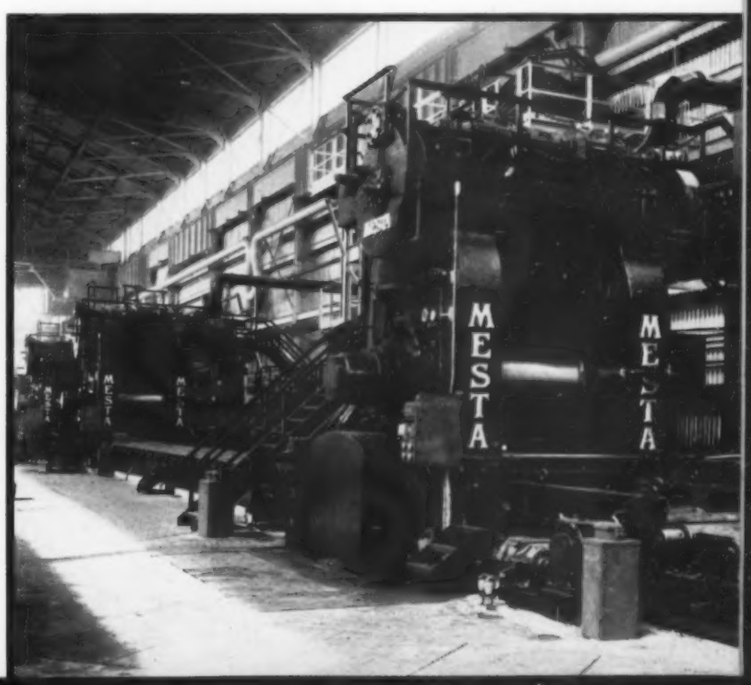
Extensive installation of new equipment and rearrangement of existing equipment in one plant will afford greatly increased finishing capacity for stainless steel strip. The work includes three additional continuous annealing and pickling lines, three new reversing cold mills, and a skin pass mill.

Some development is reported in galvanizing equipment, leading to higher speeds, tighter coating, lower dross formation, cleaner sheets and better control of the coating. The galvanizing process has been combined into a continuous line beginning with the galvanizing pots, through the spangle conveyor, cooling conveyor, primary leveler and final leveler. These lines have been

Designed for a maximum pressure between rolls of 3,000,000 lb., this horizontal roll stand installation was included in the modernization of one of the pioneer strip mills.



View showing roughing stands in a 54 in. continuous hot mill built, with cold rolling and finishing facilities, in the Chicago district during the past year.



provided with variable voltage control in order to obtain the wide speed range required by a wide range of product gauges, and to simplify the operator's problem of speed regulation.

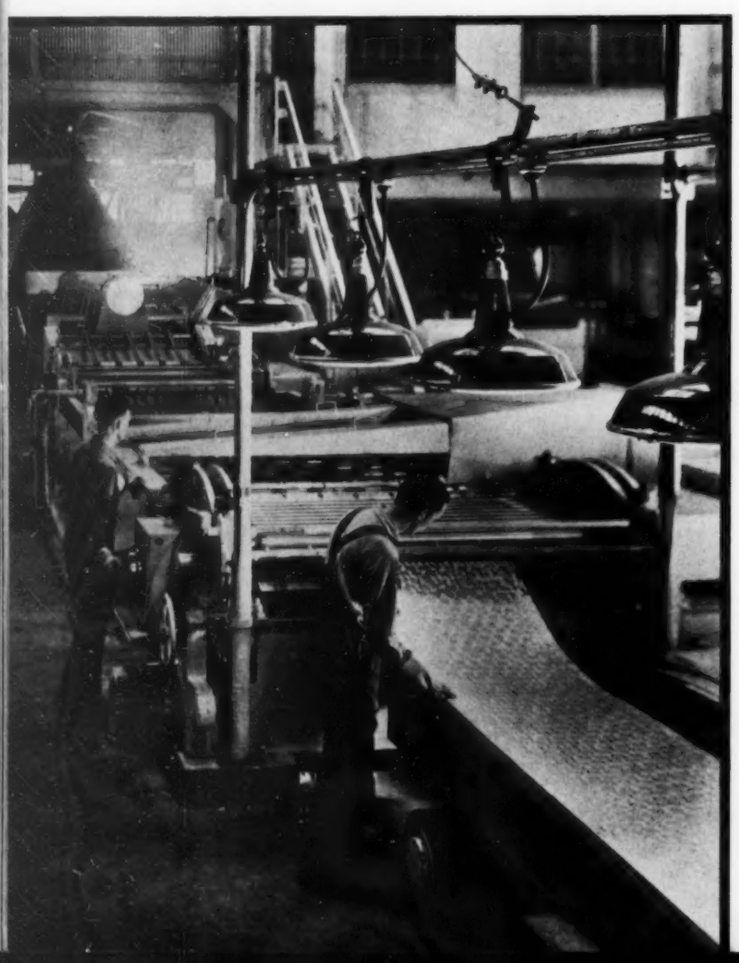
Several companies have materially expanded or improved their galvanizing capacity during the past year, with additional progress planned for the immediate future. Pot settings have been improved to obtain better pot life. Temperature of the pot is automatically controlled from a point near the exit end, assuring improved operating conditions. Each pot usually employs a set of rolls at the entering end, another set at the exit end, and one or two more sets at the bottom of the pot, depending on pot size.

The high speed at which the modern continuous pickler operates requires a high acid content in the pickling solution, which in turn, necessitates the discarding of solution while still highly acid. The disposal of this material has become a real problem, and has been the subject of a considerable amount of research.

A paper presented before the Pittsburgh District Section of the A. I. S. E. and published in January 1939 issue of the IRON AND STEEL ENGINEER, described in detail the method of disposal used in a Pennsylvania steel plant. This process neutralizes the discarded solution with milk of lime, after which the material is filtered, the residue pugged and extruded in continuous block form. This material, a mixture of iron hydroxide and calcium sulphate, has been tested out in a great variety of uses, and has shown definite values as an insulating and constructional medium. The effluent from the process satisfactorily meets all requirements.

Various other methods of acid disposal have been advanced, and current research indicates still other processes which may prove of even greater interest.

Expansion and improvements of existing galvanizing capacities were accomplished during the year, with additional progress planned for the immediate future.



MATERIAL HANDLING

A design of hot slab transfer car was built during the year, and has some outstanding features for safe handling of hot slabs without causing deterioration of the car. The underflame is of the usual construction, with rolled steel wheels and journals mounted on roller bearings, with a heavy structural steel frame well reinforced. The entire top of the car is decked over with steel plate, and above this deck are mounted supports for the hot slabs, which are made of channels with 1½ in. thick bars welded to the tops. This arrangement is provided to give greater strength, with plenty of surface area to radiate the heat, and it is to be noted that these supports are made in such a way that the crane chains or tongs can be used from either side, or from the ends. This type of construction has worked out very well in service.

One of the large steel plants installed a slow-speed remote control car or locomotive for moving the ingot cars during pouring operations, representing some outstanding developments in a self-contained drive completely mounted on anti-friction bearings, with all gears completely enclosed, and with a framework sufficiently rugged for this severe service. This car is provided with conductors, by means of which remote control of the outfit is possible from the operator's station.

Another development of unusual interest is the design of a new type of coke quenching car, which is now in course of fabrication. This car includes a number of new features, particularly with regards to the door operating mechanism, which has been greatly simplified so as to eliminate shafts, bearings, and many of the cranks and other operating parts which have been a source of maintenance expense in the past. This car also has a new design of automatic safety latch, and a mechanism for the discharge gates to prevent accidental discharge of the hot coke.

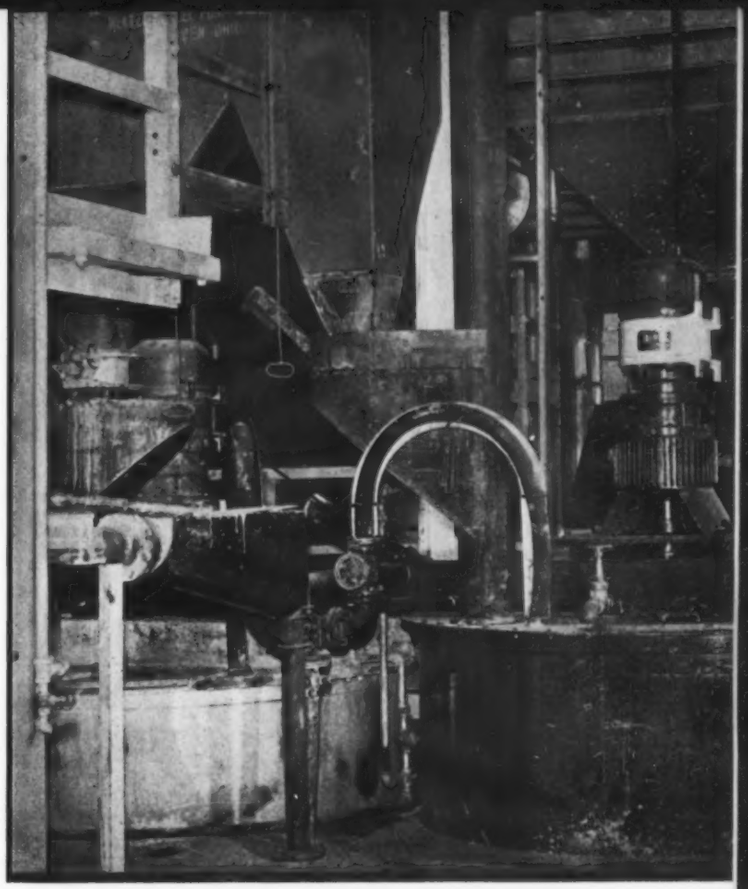
In connection with one of the large cold rolling plants, some hydraulically-operated lift trucks were installed, designed to accept the finished coil when it is pushed off by the stripper. The truck is adjustable so as to fit any size of coil which is in process of manufacture, and includes a hydraulically-operated tilting mechanism to prevent accidental discharge of the coil, in addition to a hydraulically-operated lifting mechanism and travel mechanism.

A new design of tongs for handling strip coils by crane is available, eliminating damage to the edges of thin steel strip during handling. When tongs are lowered and come in contact with the coil, a release mechanism automatically operates and jaws grip the coil as the tongs are raised. When the coil is deposited in a new location, the tongs automatically open and again lock in the open position. The tongs are of relatively light

weight, and power failure does not affect their lifting and holding ability. Pairs of coils may also be handled in the same manner.

Another development of considerable value in handling material is a light weight duplex and triplex magnet combination for handling finished coils of steel strip. Two or three round lifting magnets are incorporated into a single unit capable of lifting coils up to a maximum of 6000 lb. per magnet. Thus, a triplex unit will lift 18,000 lb., although weighing only 3700 lb. itself. These magnets can also handle the raw coils from which the finished coils were rolled up to almost the same maximum weight, provided the raw coils are banded so that they will hold together when lifted.

In the overhauling of a coal unloading tower, handling capacity was increased by about 50 per cent by replacing the operating hoist by a self-contained two drum electric-pneumatically operated bucket hoist with one-man control, and installing a 7-ton alloy steel grab bucket and a 4-ton wide spread clean up bucket. In the same plant, coke screening facilities were improved by the installation of a single deck scalping screen, a double deck sizing screen, a chain driven adjustable two-roll crusher and several belt conveyors.



The neutralization of waste pickle liquor with milk of lime in a new process developed during the year, gave promise of an early solution of a perplexing problem.

FURNACES AND REFRACTORIES

The year of 1939 has witnessed a marked growth of the portable radiant tube annealing cover in wire and high carbon specialty applications, for all phases of rod and wire spheroidizing, bright annealing, and process annealing. Much attention was given to the proper furnace atmospheres to be used in these operations, so that much pickling and cleaning is eliminated, and decarburization is prevented. The use of cracked ammonia atmospheres affords a means for surface carbon control. Furnace base design has been modified so as to further guard against air infiltration. Alloy sheaths over all base refractories eliminate contact of the atmosphere gas with them.

A great deal of attention has been paid to the mechanical handling equipment for efficient wire annealing, and such installations include loading and stripping machines to place the coils on the spindles and to remove them without scratching the wire. Spindle or spider design has been improved and better classified to suit the wire coil sizes to be handled.

In the sheet and coil annealing field, the trend is toward larger annealing covers in order to obtain higher rates of production and greater overall operating economy. The furnaces are almost completely lined with insulating material, and successful operating records have proven the durability and economy of this construction. Rectangular base design has been changed somewhat in order to obtain improved heat transfer, while structural improvements keep the base plates more nearly flat.

There has been a noticeable trend throughout the steel industry toward a more careful selection of refractories to meet the specific needs of the definite job. With higher production rates, and consequent increased penalty from furnace shutdowns, the accent has been not so much on the first cost of refractories but on the proper choice of refractories to better withstand more severe service conditions and provide greater continuity of furnace operation. In other words, ultimate overall cost is now the criterion, rather than first cost.

In blast furnace construction, new type bottom blocks were installed to eliminate joints, wear and metal penetration in blast furnace bottoms. These blocks made by an entirely new process each weighed 570 pounds, or

During 1939 several mills utilizing the Fretz-Moon process were installed. The tube mill shown below was installed in the Youngstown district.

ten times as much as the conventional block. Each measured 24 x 24 x 12 in.

A sillimanite (cyanite base) cement was used instead of the usual ground fire clay for laying brick in those parts of the furnace where joints must withstand high temperature or heavy concentrations of fluxes such as alkalies.

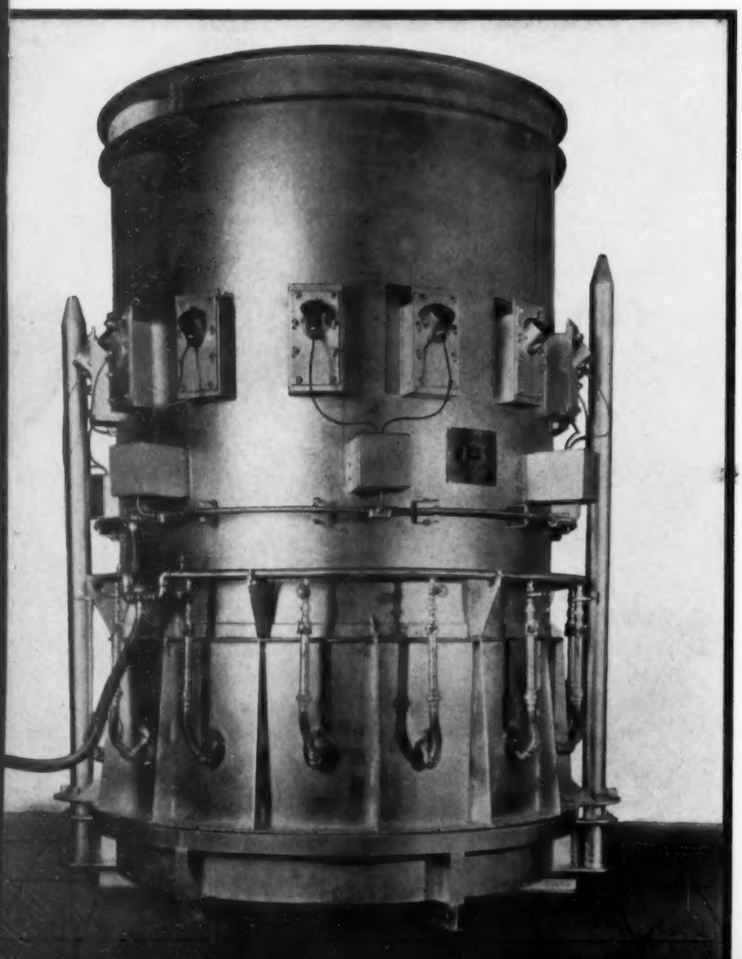
Some service conditions require magnesite brick in mixer sidewalls and pouring out spots. One survey in 1939 proved the superiority of magnesite brick over chrome brick and decided preference for chemically bonded, grain sized magnesite brick laid in a chrome-magnesite base high temperature cement free of sodium silicate.

The most interesting refractory development in the open hearth furnace was the successful substitution of unburned magnesite and unburned chrome brick for silica in the roof in those areas where silica brick have required frequent repairs. The substitution was made as "shoulders" extending several feet out from the skewbacks, most generally from the backwall. The basic bricks are laid with metal plates in the joints to reduce spalling. This composite roof construction is economical because it provides a furnace campaign without costly roof repairs and cuts down the amount of material required for maintenance of walls and banks. This use of basic brick in the roof is particularly applicable to furnaces using sloping backwalls.

Two radical departures in bottom construction were reported. In one the grain magnesite was reduced to only a few inches in depth. In the other the basic brick normally under the magnesite grains were omitted and replaced by a relatively thin layer of plastic chrome ore burnt in place. The plastic chrome ore was, of course, covered with the usual heavy layer of burnt in magnesite grains.

A result of recent development work on castable refractories is a new light weight material for making special shapes, for replacing difficult brick construction, for lining furnace doors, or for making small monolithic linings. This product is adaptable for working temperatures up to 2200 deg. F., and tests have shown it to have a very low heat storage capacity, a heat conductivity of about one-fourth that of firebrick, and marked resistance to spalling. The material may be mixed with water, cast into the desired form, and dried in twenty-four hours.

This cylindrical bell-type furnace, used for all phases of annealing, was typical of some of the recent advances made in processing equipment.



POWER GENERATION

Turbines and generators of large capacities have been chiefly of special design. In connection with a planned program of speeding up production of generating equipment, the National Defense Power Committee has recommended a certain degree of standardization in the design of this equipment. This standardization covers the following points:

CONDENSING TURBINES

Rating, kw.	RPM.	Throttle pressure, lb./sq. in.	Throttle temperature, deg. F.	No. of extraction openings
10,000	3600	650	825	3
12,500	3600	650	825	3
15,000	3600	650	825	3
20,000	3600	850	900	3
25,000	3600	850	900	3
35,000	3600	850–1250	900	4
50,000	3600	850–1250	900	4
75,000	1800	850–1250	900	4
100,000	1800	850–1250	900	4

In all of the above sizes, the recommended back pressure is 1–1½ in. Hg., absolute. Turbine capacity is placed at 125 per cent of kw. rating.

The generator design calls for an 80 per cent power factor, a short circuit ratio of .9, and an excitation voltage of 250. The preferred standard generator voltage is to be 13,800, but voltages of 11,000, 11,500, 12,000, 13,200 or 14,400 may be furnished if required to meet the needs of any existing distribution system. Above 25,000 kw., generator cooling by hydrogen is recommended, with air cooling below that size.

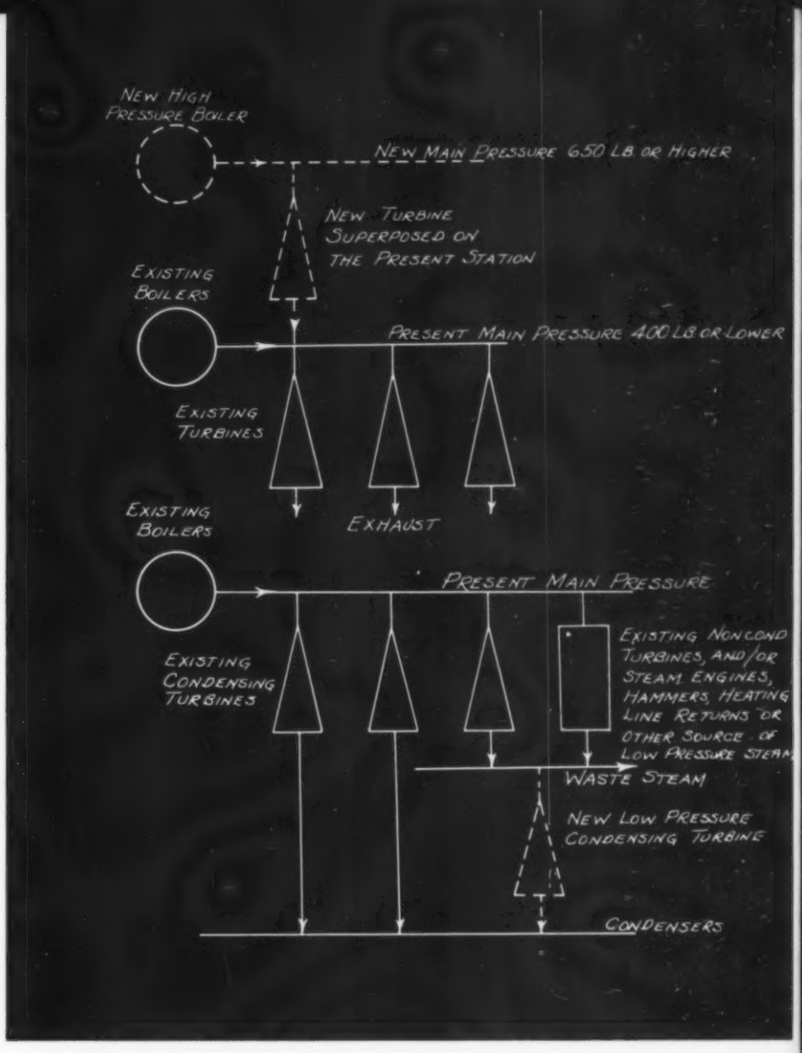
Recommendations for superimposed turbines cover sizes as follows: 10,000, 12,500, 15,000, 20,000, 25,000, 35,000, 50,000 and 60,000 kw. All of these sizes are recommended at 3600 rpm., a throttle pressure of 1250 lb. per sq. in., 925 degrees F. throttle temperature, and a back pressure of 200–300 lb. per sq. in. Turbines should have a capacity of 111 per cent of kw. capacity. Generator designs call for voltages the same as those

given above for condensing units, with a short circuit ratio of .9, and a power factor of 80 per cent. Cooling methods are as given for the condensing units.

Sufficient latitude for the modification of the standards to meet the special conditions arising in connection with the installation of new equipment in existing plants, or where unusual physical conditions must be met.

There is some expansion proceeding in power generating facilities in the steel plants. One company has placed an order for a 10,000 kw., 3600 rpm. 3-phase, 60 cycle, 6900 volt topping turbo-generator unit of the impulse reaction type, designed for steam at 800 lb. per sq. in., 800 degrees F., with 225 lb. exhaust pressure. This unit will operate in connection with existing lower pressure units. Another company is proceeding with the installation of a 30,000 kw., 25 cycle unit, operating on a 450 lb. throttle pressure and tying into the company's general power circuits.

In still another plant, four old 600 hp. boilers were replaced by two new units, each of 180,000 lb. per hr. capacity at 825 lb. pressure and 750 degrees F. temperature, fired with pulverized coal. Electric power generation will be augmented by the installation of a 10,000 kw. topping turbo-generator exhausting into the present 200 lb. steam system.


NEW HIGH PRESSURE BOILER
NEW MAIN PRESSURE 650 LB OR HIGHER
NEW TURBINE SUPERPOSED ON THE PRESENT STATION
EXISTING BOILERS
PRESENT MAIN PRESSURE 400 LB OR LOWER
EXISTING TURBINES
EXISTING BOILERS
EXHAUST
PRESENT MAIN PRESSURE
EXISTING CONDENSING TURBINES
EXISTING NON-COND TURBINES, AND/OR STEAM ENGINES, HAMMERS, HEATING LINE RETURNS OR OTHER SOURCE OF LOW PRESSURE STEAM
WASTE STEAM
NEW LOW PRESSURE CONDENSING TURBINE
CONDENSERS

Graphically shown is the superposition of a high-pressure turbine to an existing installation enabling an increase in power generation of 25 to 50 per cent.

ELECTRICAL DEVELOPMENTS

In the field of electric switching equipment perhaps the most apparent development is the trend toward a more attractive finish and appearance, but closer inspection reveals also more rugged design, with more thought to convenience and safety. A line of safety switches now incorporates a releasable interlock, permitting switch inspection without breaking the circuit, and is regularly supplied with solderless connectors and silver plated contacts. Another manufacturer has brought out a new line of direct current mill contactors, showing some major improvements and many detail improvements over the previous units.

Some developments are evident in the design of circuit breakers, with the showing of two new types of oil-less breakers. One of these, employing magnetic interruption of the arc, is designed for use with standard lift type metal-clad switch gear, and is available for 5000 volt service at interrupting ratings up to 150,000 kva. The other type, for 15,000 volt service at ratings up to 1,500,000 kva., uses a blast of high pressure air to break the arc.

Another manufacturer has developed a new line of molded case breakers with an interrupting capacity of 20,000 amperes r.m.s., 600 volts a-c., with no increase in dimensions over previous 10,000 ampere units, as well as a new line of switchboard breakers in sizes rated at 10,000, 20,000 and 40,000 ampere interrupting capacity, 225, 600 and 1600 ampere full load rating, featuring high speed, compactness and improved arc-quenching mechanism. A complete line of air circuit breakers was also announced, rated at 2500–5000 volts in 600, 1200 and 2000 ampere sizes and 75,000, 100,000 and 150,000 kva. interrupting ratings. These units are suitable for a wide variety of mountings.

A new line of combination starters has been announced, in a full line of sizes, both reversing and non-reversing, fusible and non-fusible. The principal advantage lies in a line disconnecting device constructed of contactor parts duplicating those used in the magnetic contactor of the starter, instead of a knife switch. These contactor parts are operated from a handle on the front of the case, and are arranged for quick make and break. This design gives a disconnect device of the same high opening capacity as that of a magnetic contactor, with interchangeability of parts in the two devices.

A new design of high pressure disconnecting switch employs a unique toggle mechanism in connection with right and left hand threaded studs, affording positive contact wiping by the reciprocating movement of parallel blades and by the application of high pressure by the right and left hand threaded studs. Thus, contact pressure is always constant and contact surfaces are always clean.

Isolator switches, offering the advantage of space economy, were made available in a lower voltage range.

The use of rectifiers as a source of d-c. power in the steel mill is growing slowly. One of the major steel producers has installed a 1000 kw., 250 volt unit, tying

it into the plant bus for general d-c. service. This unit is designed to operate from a 3-phase, 6600 volt supply, and consists of two assemblies of six tubes, each complete with equipment for maintaining and indicating vacuum. It has a continuous rating of 1000 kw., 250 volts, with overload capacity of 125 per cent for two hours and 200 per cent for one minute.

Systems for ventilating and air-conditioning the enclosed cabs of cranes were recently announced, contributing much to the comfort of certain cranes exposed to severe temperature or atmospheric conditions. For hot cranes, filtered air is circulated through the cab at a rate of 800 cu. ft. per min. or higher, the circulation effecting a marked improvement in working conditions. Dry ice may be used if added cooling is necessary. A small electric heater is incorporated into the systems to meet cold weather conditions. These systems may also be applied to mill pulpits or other small isolated spaces.

Another device with a wide field of possible application is a crane limit stop operating through a safety pilot circuit instead of the main circuit. The device is similar to the main circuit stops previously used and operates in a similar manner except that it opens the coils of the line contactors instead of opening the lines direct.

The high efficiency and greatly reduced heat and glare of fluorescent lighting has pointed interest in that direction, and the higher light output of the new units makes suitable their application to general overhead illumination of industrial interiors. To better apply this type of illumination, fixtures have been developed for the fluorescent units so as to give wide spread distribution of light comparable to dome-type incandescent lamp reflectors long used for industrial lighting.

The interest in fluorescent lighting has given rise to a wide development in auxiliary equipment for these lamps. Such auxiliaries indicate special attention to compactness, sturdiness, and ease of installation, and may often be installed in the lamp mounting or fixture. Ballasts have been designed for use with starters mounted in the lamp holder. An entirely new and improved thermal switch assures better starting and restarting cycles.

Other lighting fixtures show minor developments, all pointing to more rugged design and better light utilization. Hangers of the disconnecting lowering type are now available in a shock-absorbing design, as well as the old conventional styles, with fully enclosed wiring, and suitable for mounting on any type of supporting medium. Such hangers are available in a variety of finishes, for both indoor and outdoor service.

The marked increase in the demand for electric trucks of increased capacity led to the development of sizes up to 30,000 lb., which in turn demanded storage batteries of correspondingly higher capacity. This requirement was met by one manufacturer by units of up to 1000 ampere-hour capacity, assembled in steel trays instead of wood, giving strength and economy of space.

Battery maintenance has been simplified by a charging control unit which automatically controls the recharge and terminates the charge when it has been completed, eliminating under- or over-charging. Also available is a discharge indicator, which is mounted on the truck and flashes a signal light when the battery approaches a discharged condition, thus avoiding production schedule interruptions.

Continued progress made in research laboratories and checked both in proving grounds and in the field has led to further improvements in insulated wire and cable. Last year we told you about the trend toward the utilization of synthetic products in the cable manufacture. This year, we are able to point to a development that has resulted from research on one of these—neoprene.

Some years ago neoprene was developed, a rubber-like synthetic, derived from acetylene. The automotive, oil and printing industries were among those who quickly found uses for hose, gaskets and other mechanical goods made with this flexible, oil- and abrasion-resistant product.

Six years ago one cable company started utilizing neoprene to make an oil-resisting jacket for sheathing portable cords used in garages, refineries and machine shops. The industry found other uses for such cords and other manufacturers adopted neoprene for similar uses. Further research, however, convinced engineers that this material could be used instead of braids to protect any rubber-insulated cable, as it was soon found that it offered many advantages, and had good insulating qualities also. It resisted oxidation and was non-inflammable.

This year, by utilizing the strip-insulating process, and by vulcanizing in a continuous metal mold, ordinary rubber insulated wires are protected from end to end with a light-proof, air-tight sheath of this material. Braids and saturants are completely eliminated. This has been accomplished without any change being made in the conductor insulation.

This type of wire, devoid of fibrous coverings, has almost unlimited advantages. There are no braids to rot and disintegrate, no saturants to drip or clog conduits. Instead, this flexible material completely seals the insulated conductor within a permanent, tough, moisture-resisting sheath. It also adds supplementary insulating qualities.

These cables can be used wherever braided cables were previously used—in ducts or in air—and in many locations were metallic-sheathed cables have proved inadequate due to corrosion, electrolysis, etc. That braidless cables of this type are a major improvement and a real contribution to better wiring is evidenced by their rapid and wide acceptance by electrical engineers in every branch of the industry.

All paper cables require a lead sheath to keep the oil in and moisture out. Lead sheaths have had a bad habit of developing cracks through defective welds occurring during the extrusion process. These defects were difficult to eliminate because lead oxidized so rapidly while heating that successive charges could not be properly united and some of the oxides were often carried through the lead press and remained in the sheath.

By cooperation between chemists and factory engineers, a chemical treatment has been combined with a mechanical device to do away with this old trouble. Lead was treated in such a way as to "stabilize" it during processing. Sheaths made with this stabilized lead are uniform in structure from end to end and free from the bad welds and many other defects that, in the past, so often led to leaks and thence to ultimate failure.

The bugaboo of priming of centrifugal pumps located above the usual water level is to a large extent eliminated by equipment placed on the market during the past year.

In this system the water level on the suction side of the pump is automatically lifted above the eye of the impeller and continuously held there, just as if the pump were located below the supply. By merely breaking the vacuum which maintains the elevated suction level the pump can be drained completely and opened for upkeep and maintenance, without further complication.

The water level in the suction space is raised above the center of the pump when the pump is initially put into service, which generally takes from one to five minutes, depending upon the length and size of the suction piping. Thereafter, the entire suction line and the pump casing are normally kept full of fluid, so that discharge begins immediately after the motor is started, while if for any reason the priming should be lost, the pump motor is at once shut down until the water level has again been raised above the pump suction opening.

A priming chamber, mounted above and on the pump casing, contains, or is connected to, an air evacuating device, discharging to waste at some convenient point. When the ejector is started, air is withdrawn from the priming chamber, the pump casing and the suction line, and the water rises through the latter, filling the pump and eventually passing up through the wet pipe and rising in the priming chamber. The starting and stopping of the ejector is controlled by a valve operated by a solenoid energized from an electrical device which responds to the water level within the priming chamber, this same device also controlling the starting and stopping of the motor driving the main pump.

Once the pump suction chamber has been filled with water, the impeller, when rotating, can overcome the static pressure of the discharge line and the pump may be started, kept in continuous operation, or stopped, as desired. Should the suction line vacuum subsequently be reduced by air accumulation in the priming chamber (from excessive in-leakage or other cause) until the lower electrode is uncovered, the pump will at once be stopped and the submerging operation repeated. There is no danger of starting the pump prematurely or of running it after the suction has been lost.

Where the main pump can, without danger, be operated dry the submerged suction priming equipment may be arranged to prime the pump while running, requiring only a slight change in the electrical and sealing connections.

A new model scrubber for the removal of fog, dust and other particles from gas or air employs a three-step process. Gas enters the scrubber tangentially near the base, and is there relieved of coarse particles by cyclonic action. The gas then passes upward through a scrubbing zone, where slowly rotating sprays, operating at only 10 to 15 lb. pressure, are placed. Following this zone, the gas passes through perforations in a plate, increasing gas velocity. The mixture of gas, dust and mist then impinges upon wet baffles arranged so that the stream coming through the perforations in the plate strikes the baffles at maximum velocity. The dust particles are effectively held in the scrubbing liquid, which leaves the bottom of the scrubber shell through an overflow pipe. The cleaned gas continues upward around the baffles toward the top of the shell. Eliminator vanes are placed below the outlet to entrap entrained moisture.

Lubricating equipment has undergone a certain amount of refinement in design and construction which has contributed to improved operation. Beyond this, the large central oil and grease systems show essentially no particular changes, resting rather on the results of the developments of previous years. Some minor devices have been developed, however, such as a new line of visible automatic constant level oilers, with unbreakable reservoir and adjustment oil level features, which automatically maintain the proper oil level in ring or ball bearings, gear and pump housings, etc.

In response to numerous requests from manufacturers of small equipment for lubricating equipment having the features of the positive centralized system at a lower cost than that of the central pump, a multiple measuring valve manifold has been introduced, whereby a single manual grease gun connection serves several bearings. Grease is distributed under pressure to the several points in exact measured but adjustable amounts, with a tell-tale indicator to show the job is done. All operating features of the device are contained in a single steel box, which contains rotary plug valve, measuring chamber and piston, with adjusting screws and tell-tales projecting above the box for each point of lubricant application. This development provides an advanced method of lubrication for small units which will not justify the expenditure for a complete centralized system.

Several new designs of roll neck bearings have been advanced, including a spherical flood lubricated sleeve bearing and a highly developed sealed chock mounted fibre bearing. Several installations of the latter type have been made on both 2-high and 4-high hot and cold mills with excellent results. They are lubricated by circulating water with a small percentage of oil, and can run directly on the roll neck, thereby allowing a proportionately high ratio of roll neck to roll body diameter.

The application of composition bearings on mill roll necks has made gradual progress, and some of the new slabbing mill units are thus equipped. Many additional merchant mills have changed over to these bearings, and they are being tried out gradually in various strip mill applications. Additional activity in this field may be safely predicted.

A new type of bearing seal has been developed, designed to give positive sealing and thus eliminate oil leakage and oil contamination. This seal employs air at ½ to 1 lb. per sq. in. from a blower or from the common air supply. The air is introduced between two seals, one facing the lubricant supply and the other facing the coolant supply, and a barrier of air opposes entry of any contaminating agent or exit of the lubricant. The seal can be applied to any new bearing and to a great percentage of existing roll neck bearings, including the anti-friction type.

The application of anti-friction bearings has proceeded at a rate adequately testifying to the operating

advantages gained therefrom. Mill tables on almost all of the new installations, both in the United States and abroad, have been equipped with bearings of this type. Other applications, of course, are mill cranes, mill type and general purpose motors, mill machinery, etc., and in addition, almost all plants are continuing the installation of anti-friction bearings in ingot buggies and charging cars.

The installation of considerable hydraulic equipment in connection with new strip and slabbing mills has brought forth some improvement in various items of this class of equipment, and has led further toward the marketing of hydraulic descaling systems as a unit, including the hydro-pneumatic accumulator with its control panel showing all phases of water delivery and demand, and accumulator protection. A temperature control spray, with 48 stages of shut-off, was also developed.

Some very definite improvements have been made in the indicating and recording heavy-duty weighing scales, particularly in connection with the type which prints the weights on a record chart. The chart has been arranged so as to be easily accessible without requiring that the main housing be opened. Therefore, the removal of the records is much more convenient, and the scales themselves are not exposed to contamination by dirt, etc. Another feature in connection with this scale dial is the automatic recording of weights before discharge, so that there is a true record of actual weights, even should the operator neglect to make a record. This special automatic record is designated by a distinguishing mark, so that it can be easily identified for checking purposes with the weights recorded manually by the operator.

INSTRUMENTS AND CONTROLS

Instrument and control makers have done much toward improving the appearance of their products, as well as their accuracy and reliability. Instrument cases have veritably "gone modern," and the tendency is toward the use of complete unit panels carrying the instruments and controls for a particular application.

One manufacturer announced a reset potentiometer controller for continuous processes, combining a potentiometer temperature measuring system and an air-operated control mechanism. This instrument can be used for automatically controlling temperatures up to 3000 degrees F., and the throttling range and rate of reset may be changed over a wide range by a simple adjustment to suit the process involved.

Excessive friction in diaphragm control valves may be overcome by an auxiliary valve positioner, wherein the air pressure from the air controller operates the positioner, and it in turn regulates the pressure of an independent air supply to the diaphragm motor of the valve. The device assures a proportionate valve stem travel for the slightest change in pressure of the air from the controller, and is of value on all air-operated control installations where close control is important or where there is considerable process lag.

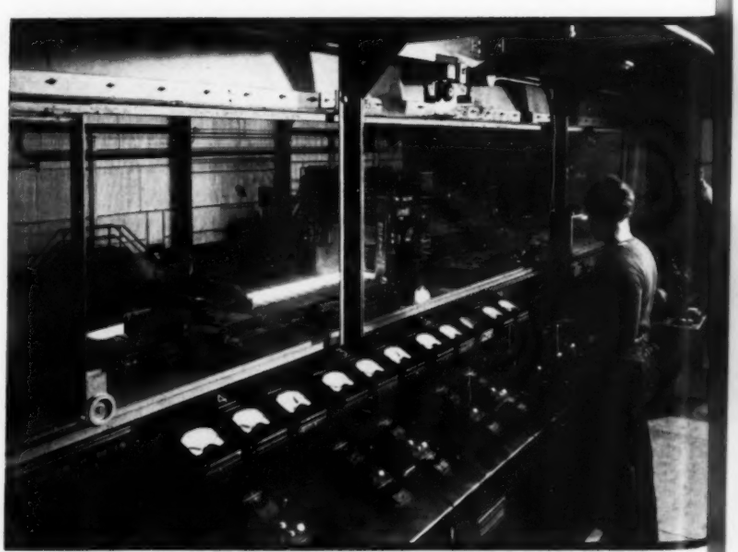
A flow ratio control device recently brought out employs two instruments: one a standard flow recorder which measures and records the rate of flow of one fluid and also sets the control point on the second instrument, which is a standard flow recorder controller controlling the flow of the second fluid proportionately to the first, depending upon the ratio selected. This ratio may be changed as desired by a simple adjustment. This device may be applied for proportioning air and fuel gas, for proportional mixing of fuel gases, for proportioning lean oil and wet gas entering an absorber, and similar uses.

A recently announced meter for measuring the flow of low pressure gas employs a ring-balance principle, in which a hollow welded steel ring is centered on ball bearings so that it can tilt freely about its horizontal axis. The hollow ring is partitioned at the top to form a U-tube, the bottom section of which is filled with a sealing oil. The chambers on either side of the partition above the sealing oil are connected by flexible tubing to small pipe connections leading to the measuring orifice taps.

Differentials set up by the orifice are transmitted to the chambers of the ring, causing the ring to tilt until the differential pressure is balanced by the movement of the calibrating weight fastened to the ring-balance. As the ring tilts, an electrical resistance scale element, also fastened to the ring, changes its position in a small mercury well, varying the electrical resistance to the reading instruments in direct proportion to the flow of gas through the orifice. This meter provides a reliable and accurate means for measuring the flow of low pressure gas, and it is particularly advantageous with a dirty or corrosive gas, due to the fact that the gas does not come into contact with the measuring elements.

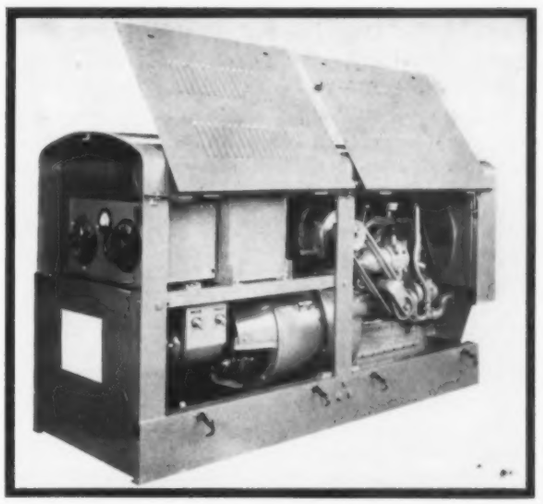
Another manufacturer completed an installation of meters measuring flow of gas to soaking pits in terms of Btu., the volumetric rate of flow being automatically compensated for changes in Btu. value of the gas as measured by a master recorder which determines Btu. per cu. ft. of gas.

Modern equipment of advanced design on the pulpit operators' boards provides for coordination of speeds and other factors giving a closer control of quality.



A thermal converter has recently been developed which, with either a direct-deflecting millivoltmeter or a potentiometer, can be used to measure a-c. power in an individual circuit, to totalize a-c. power in a number of circuits, or for telemetering a-c. power or total load. The converter, when connected in an a-c. metering circuit (secondary of a conventional set of instrument transformers), performs a proportional conversion from a-c. watts to d-c. millivolts. Thus, power load may be directly expressed by a d-c. potential difference suited to transmission over considerable distance and to totalization.

A new line of pH recorders and controllers is available, employing the glass electrode method of measurement and designed especially for industrial plant use. The shielded glass electrode is completely sealed and internally shielded from electrostatic interference. The companion calomel electrode has a factory-filled internal assembly, immersed in a saturated potassium chloride solution contained in the outer tube of the electrode. Electrolytic connection between the internal assembly and the solution to be measured is maintained through a small hole protected by a ground glass sleeve. These instruments may be used in viscous or even semi-solid substances and in rapidly circulating or flowing liquids. Temperature changes are automatically compensated.



New developments in the arc welding field include a diesel engine driven arc welder, equipped with a gasoline engine starter, which simplifies the use of diesel power in arc welding.

WELDING DEVELOPMENTS

A line of arc welders is now available incorporating a self-indicating dual continuous control. These welders have both voltage control and current control, both continuous in operation, thus providing almost unlimited selection of the voltage-current combination, so that the operation may be properly fitted to a wide range of working conditions, resulting in high quality welds and high welding speeds. Separate excitation of the generators eliminates the effect of arc conditions upon excitation. A laminated magnetic circuit is used, reducing reluctance to the flow of the magnetic flux.

A number of new types of welding electrodes were brought forth during the past year. One is an all-mineral coated rod with the coating applied by extrusion under high pressure. It may be used with either direct or alternating current, and is designed for high speed horizontal fillet welding of mild steel and for groove welding where the work can be positioned to permit all downhand welding. The rate of deposit is high, and smooth clean welds are obtained. Tensile strengths of stress-relieved welds with this rod average 63,000–68,000 lb. per sq. in. with elongations of 25–30 per cent in 2 in.

Another rod, also with a coating extruded under high pressure, is designed for welding stainless steel, and forms a weld analyzing 18 per cent chromium and 8 per cent nickel, and possessing excellent corrosion resistance. Tensile strengths of welds run from 85,000 to 95,000 lb. per sq. in. with elongations of 40–50 per cent in 2 in.

Other new electrodes have been brought out for finish bead welding on flat downhand surfaces, for building up 11–14 per cent manganese steel, for building up hard surfaces, for welding alloys up to 70–80 per cent nickel, and 11–15 per cent chromium, and other uses. A fine alloyed powder is available for surface application with the carbon arc, producing a smooth, dense, hard surface.

Welding as applied to the joining of strip in the finishing processes is accomplished largely by the electric butt method. Two recent installations, using the principle of aligning the ends of leading and tailing coils in the welding die before clamping, shearing and welding, operate with a delay of less than two minutes for shearing, welding, flash trimming and side clipping.

Assuming that the continuous pickler has been threaded, the leading coil is run into the pit ahead of the pickling tanks and the back end of the strip is cropped by an upcut shear and then moved forward to the end shearing and welding position, centered by air operated dogs, and clamped in the front welding clamp. The front end of the trailing coil is then run through the uncoiler and cropped in the upcut shear and centered and clamped in the rear welding clamp.

A rotary shear unit is then run between the front and rear welding clamps, which are spaced 24 in. apart, and both ends are sheared and matched simultaneously.

This rotary end shear unit is moved across the welder by an overhead motor driven screw and remains in its position clear of the welder and on one side of the welder until the next end shearing operation is required, when it is moved back to its original starting position.

The welder clamps are then brought up to the welding position by hydraulic cylinders and the welding cycle started. In the meantime, a hydraulic gripper has been moved up to the delivery side of the welder immediately following the front clamp and the strip is gripped ready for the flash trimming operation following the completion of the weld.

As soon as the burn-off and push-up welding cycle has been completed, the welding clamps automatically release and the hydraulic gripper automatically pulls the weld through a V-shaped plow type stripping knife which strips the weld flash from both top and bottom surfaces of the strip at the same time.

At the end of the gripper stroke, the weld is automatically placed in position for the side clippers, one on each side of the weld, so that the extremities of the weld are clipped out. The pinch rolls on the delivery side of the welder then deliver the strip into the pit ahead of the pickling tanks.

The weld is made on a slight skew so that the necessity of precision stripping is reduced, and so that no perceptible bump occurs when the weld goes through the cold mill.

The strip coil welder is designed with a minimum number of adjustments required throughout the normal range of its operation in order to avoid both the time consumed by the adjustments and the possibility of error in making those adjustments.

The 24 in. opening between the welding dies makes the dies readily accessible for maintenance. The top

TABLE 1—COMPLETE TABULATION OF CRANES, TROLLEYS, AND BRIDGES PURCHASED

Number of Cranes	Crane Capacity		Type of Bearings			Type of Gearing				Type of Current	Number of Motors	Type of Cranes	Span	Remarks
	Maximum	Auxiliary	Completely Anti-friction	Partially Anti-friction	Plain	Worm and Spur	Spur	Spur and Helical	Spur and Herring-bone					
2	½	..	Yes	...	...	...	Yes	...	...	d-c.	5	Billet charger	32′ 0″	
1	1	..	...	...	Yes	...	Yes	...	...	a-c.	1	Jib	22′ 7⅝″	
1	2	..	...	Yes	...	...	Yes	...	...	d-c.	3	Overhead	8′ 5½″	Hoist mounted on motor-driven trolley.
1	2	..	...	Yes	...	...	Yes	...	...	d-c.	3	Floor	28′ 0″	
1	3	..	...	Yes	...	...	Yes	...	...	d-c.	3	Gantry	18′ 0″	
4	3	..	Yes	...	...	...	Yes	...	...	a-c.	2	Floor	25′ 4″	
1	3	..	...	Yes	...	...	Yes	...	...	a-c.	3	Floor	48′ 4″	
2	3	..	Yes	...	...	Yes	...	...	...	d-c.	5	Soaking pit	55′ 9¼″	
1	4	..	...	Yes	...	...	Yes	...	...	Hand operated	0	Overhead	25′ 0″	
2	5	..	...	Yes	...	Yes	...	...	...	a-c.	1	Jib	Boom 19′0″ Mast 17′10⅝″	Only one jib equipped with sluing device.
1	5	..	...	Yes	...	...	Yes	...	...	a-c.	3	Floor	50′ 0″	
1	5	..	...	Yes	...	...	Yes	...	...	d-c.	3	Cage	65′ 0″	
1	5	..	...	...	Yes	...	Yes	...	...	d-c.	4	Overhead charger	25′ 6″	
1	5	..	...	Yes	...	...	Yes	...	...	d-c.	5	Overhead charger	14′ 6″	
1	5	..	Yes	...	...	Yes	...	...	...	d-c.	3	Special gantry	41′ 6″	
1	6	..	...	...	...	...	...	...	...	Hand operated	0	.....	5′ 4″	
1	6	..	...	...	Yes	...	Yes	...	...	d-c.	1	Jib	22′ 2″ Effective radius	
1	7½	..	...	Yes	...	...	Yes	...	...	d-c.	5	Overhead charger	24′ 6″	
2	7½	..	Yes	...	...	...	Yes	...	...	d-c.	3	Overhead	100′ 0″	Welded box type.
1	7½	..	...	Yes	...	...	Yes	...	...	d-c.	5	Overhead charger	24′ 6″	
1	7½	..	...	Yes	...	...	Yes	...	...	d-c.	3	Floor	47′ 2″	
1	10	..	...	Yes	...	Yes	...	...	...	d-c.	3	Standard	70′ 0″	
1	10	..	Yes	...	...	Yes	...	...	...	d-c.	5	Overhead charger	24′ 6″	Some helical gears.
2	10	..	Yes	...	...	...	Yes	...	...	d-c.	3	Standard	100′ 0″	
1	10	..	...	Yes	...	...	Yes	...	...	d-c.	2	Charging machine bridge	22′ 8″	
3	10	..	Yes	...	...	...	Yes	...	...	d-c.	3	Mill	75′ 0″	
1	10	..	...	...	Yes	...	Yes	...	...	d-c.	2	Mill	7′ 0″	Trolley only.
1	10	..	Yes	...	...	...	Yes	...	...	d-c.	2	Overhead	6′ 4″	Trolley only.
1	10	..	...	Yes	...	...	Yes	...	...	d-c.	0	Overhead	38′ 4″	
1	10	..	Yes	...	...	Yes	...	...	...	d-c.	3	Jib	Boom 22′7⅝″	
1	10	..	Yes	...	...	...	Yes	...	...	d-c.	4	Electric overhead traveling	96′ 4″	
1	10	..	Yes	...	...	...	Yes	...	...	d-c.	3	Electric overhead traveling	71′ 0″	
1	10	..	Yes	...	...	...	Yes	...	...	d-c.	3	Mill	76′ 0″	
1	12	..	...	...	Yes	...	...	...	Yes	d-c.	3	Electric overhead traveling	41′ 8½″	
1	12½	..	Yes	...	...	...	Yes	...	...	d-c.	3	Semi-gantry	72′ 0″	
1	15	..	...	Yes	...	...	...	...	Yes	d-c.	3	Electric overhead traveling	100′ 0″	Plain bearings in block sheaves only.
1	15	15	Yes	...	...	...	...	...	Yes	d-c.	4	Electric overhead traveling	100′ 0″	Plain bearings in block sheaves only.
1	15	..	Yes	...	...	...	...	Yes	...	d-c.	4	Standard	98′ 6″	
1	15	..	Yes	...	...	...	Yes	...	...	d-c.	2	Standard	4′ 6″	Trolley only.
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	5	Mill	106′ 8″	Double hook.
1	15	..	...	...	Yes	...	Yes	...	...	d-c.	2	Standard	10′11″	Trolley only.
1	15	15	...	Yes	...	Yes	...	...	...	d-c.	7	Soaking pit	68′ 0″	
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	1	Overhead	95′ 4″	Bridge only.
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	4	Overhead	110′ 0″	
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	3	Mill	100′ 0″	
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	3	Mill	100′ 0″	
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	3	Mill	75′ 0″	
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	3	Mill	75′ 0″	
1	15	..	...	Yes	...	...	Yes	...	...	d-c.	5	Mill	76′10″	
1	20	..	...	Yes	...	...	Yes	...	...	d-c.	7	Soaking pit	85′ 0″	
1	20	..	Yes	...	...	...	Yes	...	...	d-c.	4	Magnetic hand	98′ 0″	
2	20	..	...	Yes	...	...	Yes	...	...	d-c.	4	Overhead	76′ 2″	
1	20	..	Yes	...	...	...	Yes	...	...	d-c.	3	Mill	76′10½″	
4	22½	..	...	Yes	...	...	Yes	...	...	d-c.	4	Dock	20′ 0″	
1	25	10	Yes	...	...	...	Yes	...	...	d-c.	4	Electric overhead traveling	55′ 0″	Bridge axles not anti-friction.
1	25	10	Yes	...	...	...	Yes	...	...	d-c.	4	Electric overhead traveling	71′ 0″	
2	25	..	...	Yes	...	...	Yes	...	...	d-c.	3	Magnetic hand	30′ 5″	
1	30	10	...	Yes	...	...	Yes	...	...	d-c.	4	Mill	62′ 1¾″	
1	35	..	Yes	...	...	...	Yes	...	...	d-c.	2	.....	.....	Trolley only.
1	40	10	...	Yes	...	...	Yes	...	...	d-c.	5	Overhead	76′ 2″	
1	44	11	Yes	...	...	...	Yes	...	...	d-c.	5	Ladle	60′ 0″	
1	50	15	Yes	...	...	...	Yes	...	...	d-c.	6	Ladle	80′ 0″	
1	50	10	Yes	...	...	...	Yes	...	...	d-c.	4	Electric overhead traveling	74′ 6″	
1	50	10	Yes	...	...	...	Yes	...	...	d-c.	4	Electric overhead traveling	71′ 0″	
1	50	15	Yes	...	...	...	Yes	...	...	d-c.	4	Mill	60′ 0″	
1	50	15	...	...	Yes	...	Yes	...	...	d-c.	4	Standard	75′ 0″	
1	50	15	Yes	...	...	Yes	...	...	...	d-c.	4	Standard	95′ 0″	
2	60	25	Yes	...	...	...	Yes	...	...	d-c.	4	Mill	70′ 0″	
1	60	..	...	...	Yes	...	Yes	...	...	d-c.	1	Mill	55′ 0″	
1	60	20	Yes	...	...	...	Yes	...	...	d-c.	4	Standard	75′ 0″	
1	100	30	Yes	...	...	...	...	...	Yes	d-c.	7	Ladle	82′ 0″	
1	120	..	...	...	Yes	...	Yes (Stub tooth)	...	...	d-c.	4	Gantry	22′ 6″	
1	125	..	...	...	Yes	...	...	...	Yes	d-c.	5	Mill	90′ 0″	
1	175	40	...	Yes	...	...	Yes	...	...	d-c.	8	Ladle	69′ 0″	
2	175	..	...	...	Yes	...	Yes	...	...	d-c.	2	Standard	101′ 4″	
1	200	..	...	Yes	...	Yes	...	...	...	d-c.	6	Stripper	36′ 0″	
1	200	50	Yes	...	...	Yes	...	...	...	d-c.	6	Standard	65′ 0″	
1	275	..	...	...	Yes	...	Yes	...	...	a-c.	8	Gantry	63′ 6″	

half of each clamp is articulated in order to give uniform pressure on narrow or wide strip without further adjustment.

Two sets of self-centering side guides or dogs are installed before and after the two welding clamps so that the center-line of the strip is maintained before the clamping and welding operation.

The above described automatic electric welder is designed principally for large tonnages. For the small tonnage plant, or even for the large tonnage plant where the welder is separated from the continuous pickler, a strip coil welding jig has been developed. Manual gas welding is used and good rollable welds are obtained. This unit consists principally of two coil holders with an elevated clamp and welding device between the two coil holders. If two coils are to be joined together, these two coils will have their ends sheared square at the delivery end of the pickle line, and one coil placed in each of the coil holders. The ends are then placed manually in the elevated clamp and are then matched and welded.

After welding, the motor driven cradle rolls coil the first and second coils together on one side of the machine. If three or more coils are to be joined together to make a longer strip, additional coils can then be placed in the cradle on the entry side of the machine and the process continued. This welding jig is a low cost modification of the automatic gas welder, which consists of a retractable upcut shear with multiple tip gas torches working on both top and bottom of the seam at the same time.

In this more elaborate automatic gas unit the two ends of the coils are brought up and sheared while being held in clamps. The shear is then retracted and the torches traverse the seam, making the side weld. Rolls may be attached to follow the torches to flatten the weld where finished stock is being handled. No stripping of the weld is required. This welder is suitable for recoiling lines with a promise of short enough time cycle in the future for pickling lines.

Typical of the developments in the welding field is this installation of a pickling unit in a cold strip mill showing the welding of two coils together before entering the pickling tanks.

TABLE 2

TREND OF BEARING CONSTRUCTION

	Number	Crane Capacity (Tonnage)	Completely Anti-friction	Partially Anti-friction	Plain
A. Cranes	2	½	2	..	..
	1	1	..	..	1
	2	2	..	2	..
	6	3	6	..	..
	2	3	..	2	..
	1	4	..	1	..
	5	5	..	5	..
	1	5	1	..	..
	1	5	..	..	1
	1	6	..	..	1
	3	7½	..	3	..
	2	7½	2	..	..
	10	10	10	..	..
	3	10	..	3	..
	1	12	..	..	1
	1	12½	1	..	..
	1	15	1	..	..
	10	15	..	10	..
	3	20	..	3	..
	2	20	2	..	..
	4	22½	..	4	..
	2	25	2	..	..
	2	25	..	2	..
	1	30	..	1	..
	1	40	..	1	..
	1	44	1	..	..
	5	50	5	..	..
	1	50	..	1	..
	3	60	3	..	..
	1	60	..	..	1
	1	100	1	..	..
	1	120	..	..	1
	1	125	..	..	1
	1	175	..	1	..
	2	175	..	..	2
	1	200	..	1	..
	1	200	1	..	..
	1	275	..	..	1
B. Trolleys	1	10	1	..	..
	1	10	..	..	1
	1	15	1	..	..
	1	15	..	..	1
	1	35	1	..	..
C. Bridges	1	15	..	1	..

TABLE 3

TREND OF GEARING CONSTRUCTION

	Number
Cranes equipped with spur gears	70
Cranes equipped with spur and herringbone gears	5
Cranes equipped with spur and worm gears	12
Cranes equipped with spur and helical gears	1
Trolleys equipped with spur gears	5
Bridges equipped with spur gears	1

TABLE 4

SUMMATION OF CRANES, TROLLEYS, AND BRIDGES PURCHASED

Total cranes purchased	89
Total trolleys purchased	5
Total bridges purchased	1
Cranes completely equipped with anti-friction bearings	38
Cranes partially equipped with anti-friction bearings	40
Cranes equipped with plain bearings	10
Trolleys completely equipped with anti-friction bearings	3
Trolleys partially equipped with anti-friction bearings	0
Trolleys equipped with plain bearings	2
Bridges completely equipped with anti-friction bearings	0
Bridges partially equipped with anti-friction bearings	1
Bridges equipped with plain bearings	0
Total tonnage of cranes, trolleys and bridges purchased	3,027
Total motors purchased	279
Cranes, trolleys and bridges using direct current	84
Cranes, trolleys and bridges using alternating current	9
Cranes, trolleys and bridges, hand-operated	2

ELECTRIC MOTORS OVER 300 HORSEPOWER

Applied to Main Roll Drives in the Iron and Steel and Allied Industries during the year 1939

No.	Horse-power	Revolutions per minute	Volts	Fre-quency	Method of drive	Kind of mill	Purchaser	Location	Manufacturer
1	300	125–600	750	d-c.	Direct	35 in. cold strip	Weirton Steel Company	Weirton West Virginia	Westinghouse
2	(a) 300	508	2200	60	Geared	54 in. hot mill scale-breaker	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
3	(a) 300	508	2200	60	Geared	54 in. hot mill scale-breaker	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
4	350	600–1200	250	d-c.		8½ in. and 27½ in. by 30 in., 4-high	American Brass Company	Kenosha, Wisconsin	Allis-Chalmers
5	350	600–1200	250	d-c.	Geared	Brass strip mill	American Brass Company	Ansonia, Connecticut	Westinghouse
6	350	600–1200	250	d-c.	Geared	Brass strip mill	American Brass Company	Waterbury, Connecticut	Westinghouse
7	500	150–600	600	d-c.	Geared	54 in. hot strip	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
8	500	200–500	600	d-c.		48 in. temper pass	Granite City Steel Company	Granite City, Illinois	Allis-Chalmers
9	500	200–500	600	d-c.		48 in. temper pass	Granite City Steel Company	Granite City, Illinois	Allis-Chalmers
10	500	225–675	600	d-c.	Geared	Hot strip	Republic Steel Corporation	Warren, Ohio	General Electric
11	500	250–375	600	d-c.	Direct	Skin pass cold strip	Weirton Steel Company	Weirton, West Virginia	Westinghouse
12	500	300–900	250	d-c.	Geared	20–22 in. cold brass	Chase Brass & Copper Company	Cleveland, Ohio	Westinghouse
13	500	400–1100	600	d-c.	Geared	60 in. hot strip	Weirton Steel Company	Weirton, West Virginia	General Electric
14	500	850–1300	600	d-c.	Direct	Skin pass cold strip	Weirton Steel Company	Weirton, West Virginia	Westinghouse
15	700	350–875	750	d-c.	Geared	35 in. cold strip	Weirton Steel Company	Weirton, West Virginia	Westinghouse
16	800	0–37–80	500	d-c.	Direct	Reversing blooming mill	Universal-Cyclops Steel Corporation	Bridgeville, Pennsylvania	Allis-Chalmers
17	800	250–500	600	d-c.	Geared	Hot strip	Republic Steel Corporation	Warren, Ohio	General Electric
18	800	300–900	440	d-c.	Geared	50 in. 4-high reversing cold strip	Machinoimport	Moscow, U. S. S. R.	General Electric
19	800	300–900	440	d-c.	Geared	50 in. 4-high reversing cold strip	Machinoimport	Moscow, U. S. S. R.	General Electric
20	800	400–900	600	d-c.		48 in. cold reversing	Granite City Steel Company	Granite City, Illinois	Allis-Chalmers
21	800	400–900	600	d-c.		48 in. cold reversing	Granite City Steel Company	Granite City, Illinois	Allis-Chalmers
22	(a) 800	705	2200	60	Geared	4-high rolling mill	American Brass Company	Ansonia, Connecticut	Westinghouse
23	(c) 400	1750	250	d-c.	Direct	18 in. reversing cold strip	Signode Steel Strapping Company	Chicago, Illinois	General Electric
24	(c) 400	1750	250	d-c.	Direct	18 in. reversing cold strip	Signode Steel Strapping Company	Chicago, Illinois	General Electric
25	900	450	600	d-c.	Geared	Reversing hot copper	American Brass Company	Detroit, Michigan	Westinghouse
26	1000	250–750	600	d-c.	Geared	Reversing 14 in. cold strip	Allegheny-Ludlum Steel Corporation	West Leechburg, Pennsylvania	General Electric
27	1000	250–750	600	d-c.	Geared	34 in. reversing cold strip	Superior Steel Corporation	Carnegie, Pennsylvania	General Electric
28	1000	250–750	500	d-c.	Geared	Tandem cold mill	Wheeling Steel Corporation	Steubenville, Ohio	General Electric
29	1000	250–750	500	d-c.	Geared	Tandem cold mill	Wheeling Steel Corporation	Steubenville, Ohio	General Electric
30	1000	250–750	500	d-c.	Geared	Tandem cold mill	Wheeling Steel Corporation	Steubenville, Ohio	General Electric
31	1000	300	2300	60	Geared	10 in. merchant	Texas Steel Company	Fort Worth, Texas	General Electric
32	1000	400–800	600	d-c.	Geared	34 in. reversing cold strip	Republic Steel Corporation	Massillon, Ohio	Westinghouse
33	1000	500–800	600	d-c.	Geared	44–59 in. 4-high cold strip	Mitsui	Japan	General Electric
34	1200	200–400	600	d-c.	Geared	55 in. cold strip	Wheeling Steel Corporation	Steubenville, Ohio	Westinghouse
35	1500	150–300	600	d-c.	Direct	72 in. 2-high reversing hot	Mitsui	Japan	General Electric
36	1500	600–900	600	d-c.	Geared	42 in. cold strip mill	Bethlehem Steel Company	Sparrows Point, Maryland	Westinghouse
37	1500	600–900	600	d-c.	Geared	42 in. cold strip mill	Bethlehem Steel Company	Sparrows Point, Maryland	Westinghouse
38	1500	600–900	600	d-c.	Geared	42 in. cold strip mill	Bethlehem Steel Company	Sparrows Point, Maryland	Westinghouse
39	1500	600–900	600	d-c.	Geared	42 in. cold strip mill	Bethlehem Steel Company	Sparrows Point, Maryland	Westinghouse
40	1750	175–350	750	d-c.	Direct	35 in. cold strip mill	Weirton Steel Company	Weirton, West Virginia	Westinghouse
41	1750	300–600	750	d-c.	Geared	35 in. cold strip mill	Weirton Steel Company	Weirton, West Virginia	Westinghouse
42	1750	300–640	600	d-c.		48 in. cold reversing	Granite City Steel Company	Granite City, Illinois	Allis-Chalmers
43	2000	150–300	600	d-c.	Geared	55 in. cold strip mill	Wheeling Steel Corporation	Steubenville, Ohio	Westinghouse
44	2000	150–300	600	d-c.	Geared	55 in. cold strip mill	Wheeling Steel Corporation	Steubenville, Ohio	Westinghouse
45	2000	150–300	600	d-c.	Direct	55 in. cold strip mill	Wheeling Steel Corporation	Steubenville, Ohio	Westinghouse
46	(b) 2000	600	6600	60	Geared	Aluminum rod mill	Aluminum Company of America	Massena, New York	Westinghouse
47	2500	225–450	600	d-c.	Geared	Hot strip mill	Republic Steel Corporation	Warren, Ohio	Westinghouse
48	2500	250–500	750	d-c.	Direct	35 in. cold strip mill	Weirton Steel Company	Weirton, West Virginia	Westinghouse
49	(b) 3000	144	2200	60	Geared	54 in. hot strip mill	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
50	3000	200–400	600	d-c.	Geared	54 in. hot strip mill	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
51	3000	200–400	600	d-c.	Geared	54 in. hot strip mill	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
52	3000	200–400	600	d-c.	Geared	54 in. hot strip mill	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
53	3000	200–400	600	d-c.	Geared	54 in. hot strip mill	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
54	3000	200–400	600	d-c.	Geared	54 in. hot strip mill	Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	Westinghouse
55	3500	175–350	600	d-c.	Geared	60 in. hot strip mill	Weirton Steel Company	Weirton, West Virginia	General Electric
56	3500	175–350	600	d-c.	Geared	60 in. hot strip mill	Weirton Steel Company	Weirton, West Virginia	General Electric
57	3500	175–350	600	d-c.	Geared	60 in. hot strip mill	Weirton Steel Company	Weirton, West Virginia	General Electric
58	3500	175–350	600	d-c.	Geared	60 in. hot strip mill	Weirton Steel Company	Weirton, West Virginia	General Electric
59	3500	240	6600	60	Geared	60 in. hot strip mill	Weirton Steel Company	Weirton, West Virginia	General Electric
60	4000	175–350	600	d-c.	Geared	66 in. hot strip mill	Wheeling Steel Corporation	Steubenville, Ohio	General Electric
61	4000	175–350	600	d-c.	Geared	66 in. hot strip mill	Wheeling Steel Corporation	Steubenville, Ohio	General Electric
62	(a) 4000	450	6600	60	Geared	60 in. hot strip mill	Weirton Steel Company	Weirton, West Virginia	General Electric
63	(a) 4000	450	6600	60	Geared	60 in. hot strip mill	Weirton Steel Company	Weirton, West Virginia	General Electric
	100,400								

(a) Squirrel cage. (b) Synchronous. (c) Twin drive.

STATISTICS OF ELECTRIC MOTORS OVER THREE HUNDRED HP

SOLD FOR MAIN ROLL DRIVE SERVICE IN THE IRON AND STEEL INDUSTRY IN 1939

APPLICATIONS OF MOTORS TO VARIOUS TYPES OF MILLS

Type of Mill	*Number of Mills*	*Number of Motors*	*Total Horsepower*
Reversing 14 in. cold strip mill	1	1	1,000
Skin pass, cold strip mill	2	2	1,000
35 in. cold strip mill	1	5	7,000
Tandem cold mill	1	3	3,000
42 in. cold strip mill	1	4	6,000
48 in. cold reversing	1	3	3,350
48 in. temper pass, cold mill	1	2	1,000
50 in. reversing cold mill, 4-high	1	2	1,600
44–59 in. cold strip mill, 4-high	1	1	1,000
34 in. reversing cold strip mill	2	2	2,000
18 in. reversing cold strip mill	1	2	800
55 in. cold strip mill	1	4	7,200
66 in. hot strip mill	1	2	8,000
60 in. hot strip mill	1	8	26,000
72 in. reversing hot mill, 2-high	1	1	1,500
Hot strip mill	1	3	3,800
54 in. hot strip mill, scalebreaker	1	2	600
54 in. hot strip mill	1	7	18,500
10 in. merchant mill	1	1	1,000
Reversing blooming mill	1	1	800
Reversing hot copper mill	1	1	900
Brass mill	5	5	2,350
Aluminum rod mill	1	1	1,000
	29	63	100,400

Company	*Location*	*Type of Mill*	*Number of Motors*	*Total Horsepower*
Allegheny-Ludlum Steel Corporation	West Leechburg, Pennsylvania	Reversing 14 in. cold strip	1	1,000
Aluminum Company of America	Massena, New York	Aluminum rod mill	1	2,000
American Brass Company	Ansonia, Connecticut	Brass strip mill	1	350
		4-high rolling mill	1	800
	Detroit, Michigan	Reversing hot copper	1	900
	Kenosha, Wisconsin	8½ in. and 27½ in. by 30 in. 4-high	1	350
	Waterbury, Connecticut	Brass strip mill	1	350
Bethlehem Steel Company	Sparrows Point, Maryland	42 in. cold strip mill	4	6,000
Chase Brass & Copper Company	Cleveland, Ohio	20–22 in. cold brass	1	500
Granite City Steel Company	Granite City, Illinois	48 in. temper pass	2	1,000
		48 in. cold reversing	3	3,350
Machinoimport	Moscow, U. S. S. R.	50 in. 4-high reversing cold strip	2	1,600
Mitsui	Japan	44–59 in. 4-high cold strip	1	1,000
		72 in. 2-high reversing hot	1	1,500
Republic Steel Corporation	Massillon, Ohio	34 in. reversing cold strip	1	1,000
	Warren, Ohio	Hot strip mill	3	3,800
Signode Steel Strapping Company	Chicago, Illinois	18 in. reversing cold strip	2	800
Superior Steel Corporation	Carnegie, Pennsylvania	34 in. reversing cold mill	1	1,000
Texas Steel Company	Fort Worth, Texas	10 in. merchant mill	1	1,000
Universal-Cyclops Steel Corporation	Bridgeville, Pennsylvania	Reversing blooming mill	1	800
Weirton Steel Company	Weirton, West Virginia	35 in. cold strip mill	5	7,000
		Skin pass, cold strip	1	500
		Skin pass, cold strip	1	500
		60 in. hot strip	8	26,000
Wheeling Steel Corporation	Steubenville, Ohio	Tandem cold mill	3	3,000
		55 in. cold strip mill	4	7,200
		66 in. hot strip mill	2	8,000
Youngstown Sheet & Tube Company	Indiana Harbor, Indiana	54 in. hot mill scalebreaker	2	600
		54 in. hot strip mill	7	18,500
			63	100,400

TYPES OF MOTORS PURCHASED

Types of Motors Purchased	*Total Motors*	*Total Horsepower*
Alternating current motors	9	18,900
Direct current motors	54	81,500

SKIS are in the Headlines

"The fleetfooted ski patrols we're hearing about remind me of my smooth gliding for welding folks these days. Those Finns are whizzes, but here's how I go them one better:

"I can have the slope for my operations varied to suit the foray at hand. When I encounter a job that requires *high speed,* I get a *steep-slope.* When I want to *dig in,* I get a *gradual slope.* I get this cooperation from a *"Shield-Arc"*—the Welder with the Job Selector. It can be set to give any desired slope of volt-ampere curve, providing any TYPE of welding arc to suit the job. *"Shield-Arc's"* Current Control varies the arc INTENSITY. Job Selector and Current Control are each *self-indicating* and provide *continuous selection* for *accurate* results every time.

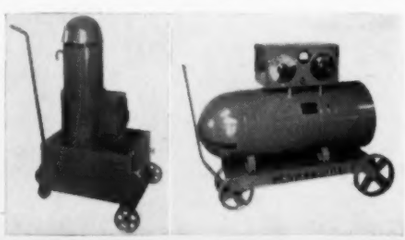
"That's why you'll find me at the front in Welding Performance, turning profit marauders to flight.

"Yours for lower costs,

"FLEETWELD ROD," Emissary of—

THE LINCOLN ELECTRIC COMPANY
Largest Manufacturers of Arc Welding Equipment in the World

"SHIELD-ARC JR." —world's most popular low-priced d.c. welder. For a wide range of welding and hard-facing applications. In ratings of 75, 100, 150 and 200 amps. Price $158 to $243 F.O.B. Cleveland, freight prepaid.



IT WON'T BURN OUT! This *"Shield-Arc"* Welder is completely protected from burn-out, due to any cause. This makes possible sustained operation with large electrodes for faster welding and lower costs.

"Give the nearest Lincoln office a call or mail the coupon for details"

LINCOLN *"SHIELD-ARC"* WELDERS
The *head line* for profits on the welding front

THE LINCOLN ELECTRIC CO., Dept. Z -2, Cleveland, O.
Send free bulletin on ☐ "New Arc Welding Technique" ☐ New motor-driven *"Shield-Arc Jr."* ☐ New motor-driven *"Shield-Arc."*

Name _____ Position _____
Company _____
Address _____
City _____ State _____

NEW TRUCKS SPEED MATERIAL HANDLING

▲ The latest addition to the line of industrial trucks manufactured by the Baker-Raulang Company is a new gasoline-powered fork truck. The engine of this new series of trucks is a 4-cylinder industrial engine designed for continuous operation at high power output, and is rubber mounted to reduce vibration. Heavy-duty industrial type transmission and clutch are used, the gearbox providing two speeds forward and two reverse. The power axle is a standard worm drive, single reduction axle which has been used for many years in these electric trucks and combines maximum efficiency with low maintenance and complete silence under all load conditions. The steering axle at the rear of the truck is of the wide-angle steer type, permitting utmost maneuverability in the smallest space. Hydraulic brakes are provided on the drive wheels and all controls are of the automotive type.

Lifting and tilting motions are accomplished by a hydraulic system incorporating the latest developments in this type of equipment and consisting of a gear pump driven continuously from a power take-off and connected to the lifting and tilting jack cylinders through suitable control and relief valves. The control valves are of the type permitting absolute control of the speed at all times.

Travel speeds are normally governed to 7 mi. per hr. in accordance with latest safety recommendations but higher speeds are available if desired. Lifting speeds are up to 30 ft. per min. and lowering speeds to 75 ft. per min. Forks may be had in any length desired. With the standard overall height of 88 in. permitting entry into a boxcar, the non-telescoping truck has a fork lift of 70 in. and the telescoping model up to 124 in. Under normal conditions, the trucks will operate in 6 ft. intersecting aisles.

This new truck is powered by a four-cylinder gasoline engine, and is designed for continuous operation at high power output.

BETHLEHEM ORDERS NEW GAS SCRUBBER

▲ Bethlehem Steel Company has awarded a contract to Peabody Engineering Corporation for a blast furnace gas scrubbing installation. It will be located in the top of a tower washer through which gas passes before entering an electrical precipitator. This will be the third scrubbing unit of this type to be installed by the Bethlehem Steel Company.

UNITS FOR HEATING INDUSTRIAL PLANTS

▲ Many industrial plants such as large factories, steel mills, finishing mills, assembly plants, large foundries, etc., have not only large floor areas but extremely high ceilings. To properly heat these plants requires a unit that will deliver the air at a high velocity and at a high temperature.

To take care of requirements such as the above, Surface Combustion Corporation, Toledo, Ohio, has a

gas-fired unit heater for operating on manufactured, natural, butane, or propane gas. The unit has an input capacity of 1,250,000 Btu.'s per hour and an output of 1,000,000 Btu.'s. Air delivery is 10,000 c.f.m. with an average temperature rise of 125° F. Air velocity is approximately 2500 feet per minute making possible a throw of approximately 175 feet with an outlet temperature of 175° to 185°.

The unit is of the floor type design, three feet in width and 10 feet, 9 inches in length. This unusually small width makes it practical to install the heater next to a wall or between columns without taking up any large amount of productive floor space. The unit is 8 feet, 3 inches high. The net weight is 5,200 pounds. With the exception of the controls being boxed separately, the unit is shipped completely assembled.

This new unit is equipped with four air outlets, each of which is equipped with horizontal louvres of the adjustable type. Each outlet is located on top of the heater and can be rotated throughout a complete circle permitting discharge of the air in any desired direction. If desired, duct work may be attached to the outlets.

Air is circulated by two large fans. A third fan for delivering air to the burner is mounted on the common fan shaft, which is driven by a 7½ horsepower motor.

BREAKER USES STORED ENERGY IN OPERATION

▲ A new oilless circuit breaker, which uses the prestored energy of compressed air for the two-fold function of breaker operation and arc interruption, has been announced by Allis-Chalmers Manufacturing Company.

The new breaker consists essentially of an air storage tank containing compressed air, a main air blast valve, three interrupting chambers mounted upon hollow insulator supports, three exhaust mufflers or coolers integrally mounted with the interrupting chambers, and isolating contacts connected in series with the interrupting chambers, also mounted on insulator supports. Each interrupting chamber has a hollow stationary contact forming a port or entrance to the muffler. The movable contact in making contact with the stationary contact closes the port and is normally held in this position by heavy springs.

The interrupting process is initiated by admitting compressed air to the interrupting chamber through the air blast valve. The compressed air operating against a piston attached to the movable contact, causes the contacts to separate, thereby providing an outlet through which the compressed air escapes into the cooling chamber. As the contacts separate, an arc is drawn, which is immediately enveloped and centralized by the action of the air blast. Extension and centralization of the arc automatically connects a resistor in parallel with a portion of the arc, thereby eliminating high frequency transients and reducing the rate of rise of recovery voltage.

Due to the dynamic, dielectric and cooling effects of the air, coupled with the beneficial action of the resistor, a guillotine-like arc interruption characteristic is obtained, which is so efficient that arcing times of one half cycle or less are consistently produced. The breaker is rated 600 and 1200 amperes at 15 kv. with 23 kv. insulation and interrupting capacity rating of 500,000 kva.

10 ton, 65′-0″ span Cleveland steel-mill crane.

LOWER COSTS WITH CLEVELAND ALL-WELDED CRANES

Because maintenance of Cleveland all-welded cranes is little more than a periodic lubrication job, their operating costs are very low.

Of greater importance, they are always ready to serve, and lost time, due to lack of crane service, is practically eliminated.

Mill men, who know, are in general agreement that costs are lower with Cleveland all-welded cranes.

THE CLEVELAND CRANE & ENGINEERING CO.
Wickliffe, Ohio

CLEVELAND CRANES
ALL-WELDED OVERHEAD TRAVELING CRANES
Other products: CLEVELAND TRAMRAIL and STEELWELD MACHINERY

PORTABLE TOOL STAND FOR SHOP MECHANICS

▲ A portable tool stand for all classes of shop mechanics has been devised by the Electric Service Supplies Company. With this portable tool stand, tools are not so readily misplaced, lost or damaged. The height of this stand is 32 in. (including casters), the width 24 in., and the depth 18 in. The drawer dimensions on the inside are

17 in. width, 15¾ in. depth, and 5 in. height.

Finished in olive green enamel which is baked on, the tool stand is made of No. 18 gauge steel, consisting of three shelves, with the drawer under the top shelf.

ARC WELDING AWARDS TO BENEFIT INDUSTRY

▲ A two and a half year program of scientific study, which will culminate in payment of $200,000 in awards, and which should produce widespread social and industrial benefits, was announced here today by The James F. Lincoln Arc Welding Foundation. The 458 awards are established for studies bringing out benefits of a social, economic or commercial nature, such as reduction or elimination of hazards to safety and health, greater availability of comforts and conveniences through reduced prices, greater utility and durability of machines and structures as well as industrial benefits such as cost savings and other advantages in manufacture, fabrication or construction.

Studies encouraged with a view to creating such large-scale benefits will concern machines, products and structures of all types including: automobiles, trucks, buses, airplanes, locomotives, freight and passenger cars, street cars, ships and boats of all types, buildings, bridges, houses, furniture, heating and air conditioning equipment, electric refrigerators, farming machinery, road-building equipment, as well as industrial machines and products of every conceivable kind.

AWARDS

The 1st Grand Award, which will be paid for the best progress report submitted, will total $13,700.

3 Main Program Awards: 1st, 2nd and 3rd awards of $10,000, $7,500 and $5,000.

The roll shown in this unretouched photograph is typical of rolls used for rolling different kinds of sheet and strip of metals and other materials which must have a smooth, highly finished, flawless surface. To roll such sheets the rolls must be accurately ground with a highly reflective surface as shown.

This is routine work for Farrel Roll Grinders. Their precision construction and many superior design features enable them to grind rolls of any material with any desired finish which can be obtained with wheels at present available. Their smooth, vibrationless operation produces a perfect surface free from marks of any kind.

And when it is necessary to cut deep to remove stock their rugged construction permits the heaviest roughing cuts to be taken. They are designed and built to perform the whole range of roll grinding operations from roughing to the finest mirror finish.

Send for a copy of Bulletin No. 111 describing the features of design and construction which contribute to the high-accuracy, high-output, low-cost performance of Farrel Roll Grinders.

FARREL FARREL-BIRMINGHAM COMPANY, Inc.
ANSONIA, CONN.
New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

48 Classificational Awards: 1st, 2nd, 3rd and 4th awards of $3,000, $2,000, $1,000 and $800, respectively, in each of 12 classifications.

184 Divisional Awards: 1st, 2nd, 3rd and 4th awards of $700, $500, $250 and $150, respectively, in each of 46 divisions.

223 Honorable Mention Awards: 223 awards of $100 each for papers which do not share in any other awards but which deserve honorable mention.

CLASSIFICATIONS

A—automotive; B—aircraft; C—railroad; D—watercraft; E—structural; F—furniture and fixtures; G—commercial welding; H—containers; I—welderies; J—functional machinery; K—industrial machinery; and L—maintenance.

PARTICIPATION

Participation in the program is open to everyone who plays any part in actually bringing about progress in the executive, design, fabrication, manufacture, construction or maintenance phase of industrial product or structure development. Authors of studies may be executives, engineers, designers, architects, draftsmen, plant superintendents, production managers, foremen, proprietors of automotive garages or service stations, owners and operators of fabricating and repair shops, or any other person engaged in the various phases previously mentioned. One author, or a group of authors, may submit a study. Any company or concern may submit more than one study, provided each is on a different subject and is prepared and submitted by a different author or group of authors.

Studies may bring out any and all social, scientific, economic and commercial benefits which attest progress in industrial development. Studies must, however, report progress which can be attributed to application of the electric arc process of welding within the two and a half year period, January 1, 1940 to June 1, 1942. Such progress may involve one of the following: (a) redesign and manufacture or construction of an existing machine, structure, building, manufactured or fabricated product of ferrous or nonferrous metals; (b) new design and manufacture or construction of a machine, building, etc. as in (a); (c) organization, development and conduct of a welding service; (d) development, planning and performance of maintenance or repair work with arc welding.

Dedicated to general industrial progress, through scientific interest in and study of arc welding, this $200,000 award to stimulate widespread study should be productive of far-reaching benefits.

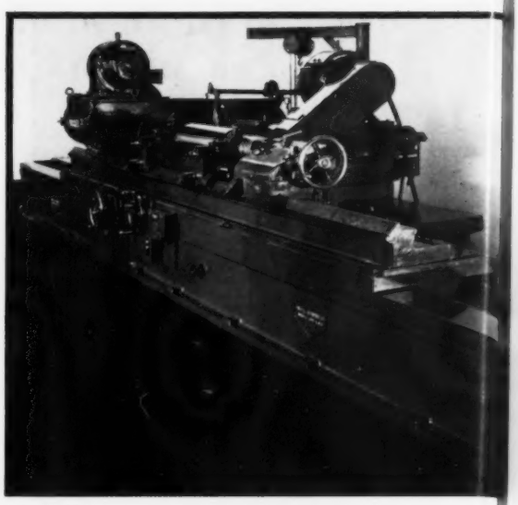
Participants in the program have until June 1, 1942 to pursue their studies and prepare a report summarizing them. All those planning to qualify should record, for future reference, data in the form of designs, charts, photos, notes and other pertinent information on operations as of December 31, 1939. All inquiries concerning the $200,000 Industrial Progress Award Program should be addressed: Secretary, The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

WIRE STRIPPER UNIT SPEEDS PRODUCTION

▲ A new, lower cost, power-driven, brush-type wire stripper has been announced by the Ideal Commutator Dresser Company. This new unit greatly speeds up production work in stripping wires. A vacuum attachment draws the insulation materials into a drawer in the base of the unit, thus eliminating dust and dirt of stripping operations.

The stripper strips cotton and enamel, silk and enamel, string asbestos and other light insulations from round, flat or rectangular solid or stranded wire. It is especially effective in cleaning fine "Litz" wires, in removing gummy insulation imbedded in stranded wires and in cleaning the new "Formex" magnet wire.

Operation of the new wire stripper is by single, direct-belt drive from the ¼ hp. motor to the special steel wire brushes. The speeds of the brushes are synchronized through an auxiliary, flat-belt drive which also operates the vacuum exhaust. Other important features include: streamlined cover enclosing the unit for protection of the operator; uniform length of stripping assured by stop adjustment knob located on top of the case; brush clearance adjustment made by large bakelite knob on top of case; brushes held apart against spring tension action, which allows assorted sizes of wires to be stripped without frequent adjustment of brushes, and prevents stalling motor with oversize wire.



The new cylindrical grinder consists of a front bed upon which is superimposed the traveling work table running on inverted V-ways.

CYLINDRICAL GRINDER HAS NOVEL FEATURES

▲ A new cylindrical grinder with several novel and improved features has recently been developed by Farrel-Birmingham Company, Inc., machinery manufacturers of Ansonia, Conn., and Buffalo, New York. This machine incorporates a traveling work table and a fixed grinding wheel unit, and is equipped with a sensitive reversing mechanism which permits grinding right up to the shoulder of the shaft. Once set, the traverse and reversal of the traveling work table are automatic and require no further attention from the operator.

The new cylindrical grinder can be set for any work and then operates automatically. All mechanical and electrical operating controls are within easy reach of the operator's station and so conveniently arranged that he has complete control of the grinding without leaving his position.

To permit moving the traveling table by hand a handwheel and clutch are provided and there is also handwheel control for hand-feed of the grinding wheel as well as electrical controls for rapid in-and-out movement of the wheelhead. The traveling table may be reversed by hand or automatically and lever contact control is provided for rapid traversing of the table. Start and stop push-button stations control the motors driving grinding wheel, traveling table and water pump, and a start-jog-stop station controls the headstock. There

is also an emergency master stop station, with re-set button and red indicating light.

The design of the work table drive has been improved to secure positive, vibrationless traverse, steadiness of travel and smooth, accurate reverse. The table is driven by an adjustable speed reversing motor.

ACME STEEL ORDERS COLD REDUCTION MILL

▲ Acme Steel Company, Chicago, Illinois, has ordered a complete four-stand, four-high tandem cold reduction mill with auxiliary equipment from the United Engineering and Foundry Company.

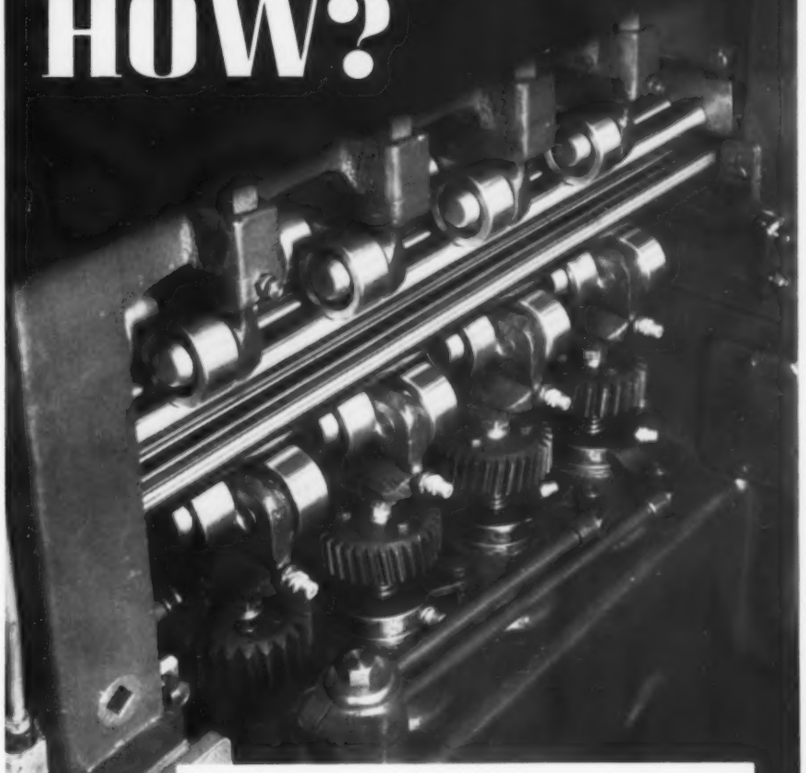
A wide variety of gages of steel is to be rolled on this mill, and an unusual speed variation of the roll stands is required. Many other features not commonly found on a tandem cold mill will be incorporated to meet the company's specific requirements in cold rolling.

The mill will be equipped with a novel means for entering the strip in the work rolls and guiding its lateral displacement across the face of the rolls irrespective of strip width, thereby allowing uniform roll wear. The tension reel at the delivery end will be equipped with a belt wrapper so arranged as to receive the narrow stock regardless of its position in the mill. Change gear units are incorporated in the drives of the first two stands with all stands having a 3:1 speed range of the driving motor.

CONTROLLED HEAT IN NEW SOLDERING IRON

▲ Two new soldering irons of the open-flame type have been announced by The Linde Air Products Company, a unit of the Union Carbide and Carbon Corporation. These soldering irons, available as part of the "Prest-O-Lite" line of air-acetylene equipment, offer distinct advantages to the user. A constant source of just the right amount of heat is provided by the air-acetylene flame. This heat is

Backed Up HOW?



MOST important about a backed up roller leveler is *how* it is backed up. Today's Ungerer leveler, with its narrow and independently adjustable back-up rollers, was developed seven years ago, replacing the old-style long roller design.

As a result, the rolling industries have gained their most effective means of flattening both sheet and strip.

Edward W. Voss
MACHINERY
2882 WEST LIBERTY AVENUE
DORMONT · PITTSBURGH, PA.

instantly available, and once the work is started there are no interruptions to reheat the copper, since the flame is an integral part of the soldering iron. In addition, the copper is kept at a constant temperature due to the stability of the flame. These factors mean increased operating speed with resultant economy, and unusually uniform results.

The small soldering iron is particularly well suited for automotive, electrical, telephone switchboard, and radio work, while the standard soldering irons are capable of handling all but the heaviest operations. Both the small and the standard size are furnished with pointed-type coppers, but chisel-type coppers for the small iron, and chisel- and hatchet-type coppers for the standard iron are also available. In addition, the standard iron can be supplied with a needle valve in the handle which permits exact regulation of the flame. This feature makes the iron particularly suitable for outdoor work, especially in cold and wintry weather.

NEW PRINCIPLE IN STRAIGHTENER UNIT

▲ A new straightening machine for rounds, pipe and tubes has been developed by Mackintosh-Hemphill Company. This machine employs an entirely new principle of straightening, which has proven very successful. The straighteners have been designed for the maximum of accessibility and speed of roll changes. The principles upon which the straightener operates results in superior straightening affect, greater roll life, elimination of end bends, no guides to score the stock, less consumed power and greater speeds of production.

These machines are also built as sizers for both rolled and drawn bars, to produce accurate rounds within the most exacting requirements. A complete line of machines, suitable to handle all sizes of bars and pipe are available.

NEW CAPACITORS USE WELDED SHEET STEEL

▲ For power-factor improvement in industrial plants General Electric Company offers a group of new Pyranol capacitor equipments, designed to be mounted either on a platform, on the floor, or suspended from the ceiling. The new capacitor equipment is built of all-welded sheet steel, which makes it a strong, rigid rack of smooth, pleasing appearance.

While the bodies of the capacitor units are exposed to a stream of ventilating air, the bushings, buses, and fuses are enclosed in a dust-tight compartment, eliminating any possible difficulties from dust and dirt accumulation. Conduit knockouts are provided on top and both sides for ease in making connections. There are no external discharge resistors in these new units as the resistors are built-in. All the fuse clips and fuse ferrules are silver-plated to eliminate oxidation.

Feet are provided on these capacitors for floor or bracket mounting and there are also eyes for lifting and suspension from the ceiling. Since most factories consider floor space as valuable, this feature is a distinct advantage. Switches may be mounted on pillars of walls when the units are suspended from the ceiling.

DEVELOP SLIDE RULE FOR STAINLESS STEEL

▲ A stainless steel machinability "slide rule" incorporating the condensed findings of two years of intensive research on the machining of stainless steel, has been produced by Rustless Iron and Steel Corporation here for men and firms engaged in fabricating the metal.

The research program was carried on by a force of machinists and metallurgists, and covered the turning, forming, threading, drilling, tapping and reaming of stainless steels. Thousands of samples were machined at various speeds, and with various types of tools.

By setting the slide on the chart to the type of stainless steel to be machined, data on speeds, feeds, and cuts may be read directly. The reverse of the chart carries suggestions as to tool design, grinding and coolants.

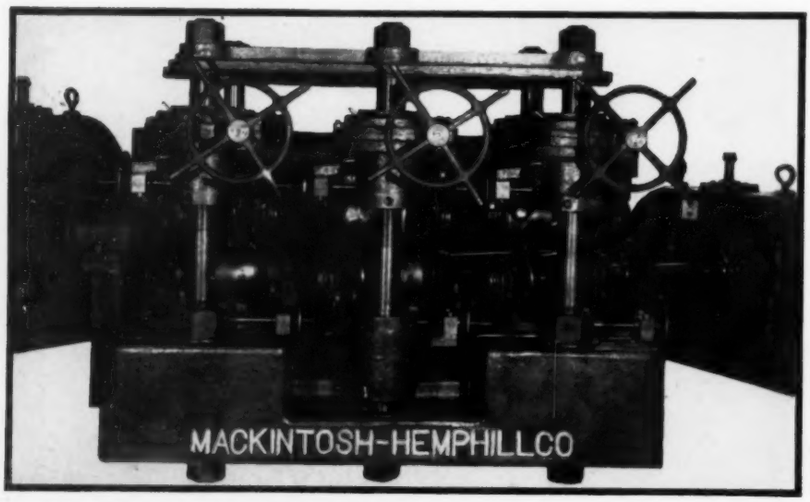
WELDED KETTLES FOR DUMPING MILL REFUSE

▲ Welded steel refuse kettles suitable for use in steel, smelting, refining, chemical and other industries, have been introduced by the Treadwell Construction Company. These kettles are made of special fire-box quality and are of all-welded construction.

With a rated capacity of 19½ cu. ft., these kettles have an inside

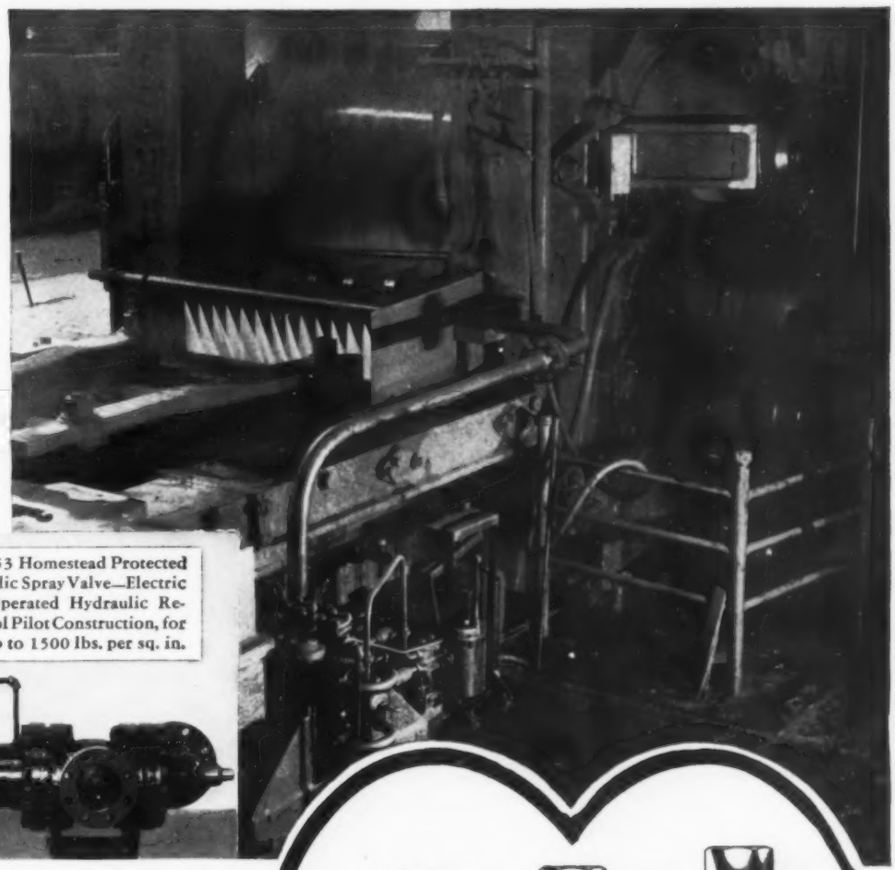
(Continued on page 81)

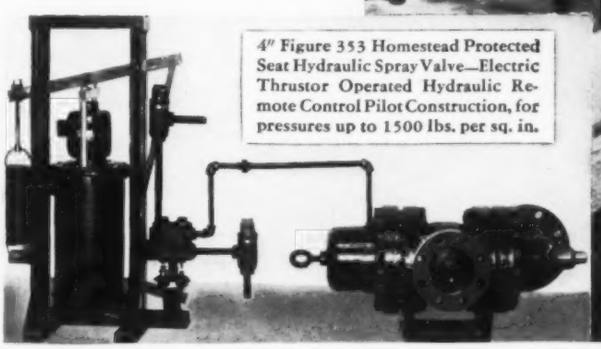
This straightening machine, for rounds, pipe and tubes, has been designed for the maximum of accessibility and speed of roll changes.



It Pays To Know The Facts About The Spray Valves With Lowest Maintenance

HOMESTEAD PROTECTED SEAT DESCALING VALVES





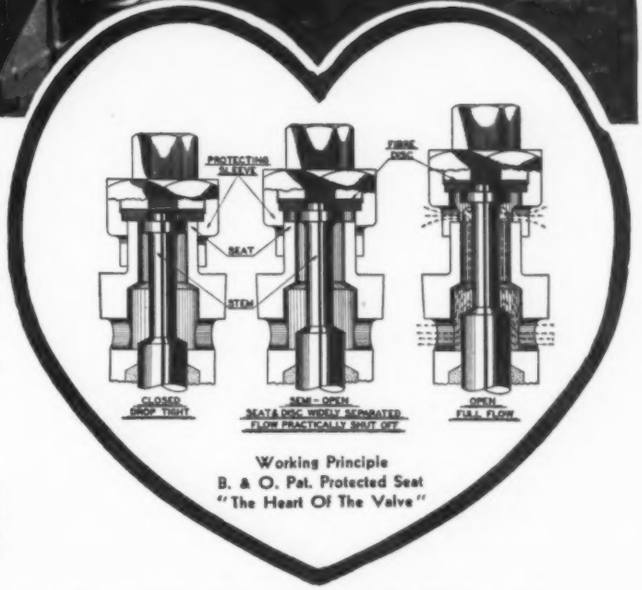
4" Figure 353 Homestead Protected Seat Hydraulic Spray Valve—Electric Thrustor Operated Hydraulic Remote Control Pilot Construction, for pressures up to 1500 lbs. per sq. in.

More than four years of continuous operation, with less than five dollars per year maintenance—that is the record of seven 3-in. HOMESTEAD Protected Seat Spray Valves controlling high pressure hydraulic spray on descaling systems in one of America's busiest Hot Strip Mills.

This is typical of the records of all installations of HOMESTEAD Protected Seat Spray Valves—the ONLY valves that can give you ALL of these profit-guarding features:

(1) B & O Patented Protected Seat
(2) A Principle Proved by More Than 2200 Installations
(3) Positive Patented Shock Elimination
(4) Low First Cost
(5) Lowest Maintenance (time, labor, material)
(6) Extremely Low Pressure Drop
(7) Ease of Operation

We invite your investigation and comparison of HOMESTEAD Protected Seat Spray Valves on all these points. In the interest of keeping your operating costs low, investigate before you invest in a hydraulic descaling system. Get the facts from Reference Book No. 38. Write for your free copy.



Working Principle
B. & O. Pat. Protected Seat
"The Heart Of The Valve"

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HOMESTEAD VALVES

QUARTER-TURN VALVES:
STRAIGHT-WAY
THREE-WAY
FOUR-WAY
LUBRICATED TYPE
LIFT-TYPE PLUG

PROTECTED-SEAT VALVES:
HYDRAULIC (B. & O. PAT.) OPERATING
REMOTE CONTROL
HYDRAULIC DESCALING
ROSS AIR SHUT-OFF VALVES
HOVALCO BLOW-OFF VALVES

NEW MEMBERS

Active

W. J. Dawson
Director and Metallurgist
Hadfields Limited
Hecla Works
Sheffield, England

D. N. Evans
Lubrication Engineer
Inland Steel Company
East Chicago, Indiana

Harold M. Flaherty
General Foreman, Charge Scarfing
Carnegie-Illinois Steel Corporation
Duquesne, Pennsylvania

L. A. Hasenauer
Engineer
Republic Steel Corporation
Corrigan-McKinney Plant
Cleveland, Ohio

C. L. Huston, Jr.
Director Personnel Relations
Lukens Steel Company
Coatesville, Pa.

Charles E. Kew
General Foreman, Locomotive Shop
Bethlehem Steel Company
Bethlehem, Pa.

Joseph W. Koss
Turn Foreman
Cold Strip Mill
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania

R. L. Livingston
Electrical Engineer
Carnegie-Illinois Steel Corporation
Irvin Works, Dravosburg, Pennsylvania

Robert N. Merk
Open Hearth Engineer
Carnegie-Illinois Steel Corporation
Farrell, Pennsylvania

C. F. Negele
Asst. Engineer, Appropriations and Properties
American Steel and Wire Company
Cleveland, Ohio

Ernest Schlup
Electrical Engineer
American Rolling Mill Company
Middletown, Ohio

H. H. Shakely
Master Mechanic
Hot and Cold Strip Mills
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania

Alvan E. Swain
High Pressure Valve Designer
Florence Pipe Foundry and Machine Co.
Florence, New Jersey

Russell L. Taylor
Foreman, Steam and Gas Department
Worth Steel Company
Claymont, Delaware

John D. Watson
Chief Electrician
Electrical Dept., Hot and Cold Strip Mill
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania

Associate

T. J. Barry
Owner
T. J. Barry Company
(Industrial Sales)
Pittsburgh, Pennsylvania

Winfield Scott Evens, II
Mechanical Engineer
H. A. Brassert and Company
Chicago, Illinois

J. R. Graves
District Representative
Battery Division
Philco Radio and Television Corp.
Philadelphia, Pennsylvania

M. O. Herbster
Salesman
Westinghouse Electric and Manufacturing Co.
Philadelphia, Pennsylvania

Otto J. Leone
Sales Engineer
Bristol Company
Pittsburgh, Pennsylvania

F. J. McCullough
Sales Engineer
Moloney Electric Company
Chicago, Illinois

Arthur G. McKee
President
Arthur G. McKee and Company
Cleveland, Ohio

T. B. Montgomery
Control Engineer
Allis-Chalmers Mfg. Company
Milwaukee, Wisconsin

W. Morrison
Sales Representative
Brooks Oil Company
Industrial Division
Pittsburgh, Pennsylvania

Paul H. Oberreutter
President and Chief Engineer
Mid-West Dynamometer and Engineering Co.
Chicago, Illinois

Harry E. Reith
Lubrication Engineer
Industrial Division
Brooks Oil Company
Pittsburgh, Pennsylvania

Joseph L. Thomas
Service Engineer
Linde Air Products Co.
Detroit, Michigan

W. J. Wenger
Assistant Metallurgist
Birdsboro Steel Foundry and Machine Co.
Birdsboro, Pennsylvania

William S. Wheeler
Vice President and Treasurer
Pennsylvania Engineering Works
New Castle, Pennsylvania

George D. Winlack
Steel Mill Engineer
Air Reduction Sales Company
New York, New York

Roy L. Wolter
Sales Manager
Automatic Transportation Co.
Chicago, Illinois

(*Continued from page 76*)

diameter at the top of 42 in. and an inside depth of 24 in. The top flange, 1½ in. thick, is slotted to receive swing bolts. The bottom of the kettle is a standard ellipsoidal head of ⅝ in. thick plate. The kettles are so designed, and the inside contour is such as to assure self-clearing when the kettle is dumped.

NEW LITERATURE

▲ Leeds and Northrup Company has issued the following catalogues which may be secured by writing to this company at 4934 Stenton Avenue, Philadelphia, Pennsylvania:

Catalogue E—A 66-page, condensed book, listing the entire line of instruments for research and for routine testing in laboratory, plant and field. Every standard item is briefly described, and most of the principal ones are illustrated. For more complete descriptions and supplementary information, the reader is referred to the detailed publications. However, many instrument users will find this condensed catalogue a useful guide.

Catalogue N-33B—A 40-page catalogue entitled: "Micromax and Speedomax Rayotube Pyrometers," contains descriptions of Rayotubes in a variety of applications detecting temperatures of work in motion. Diagrams are also included showing the various methods of applying these detectors.

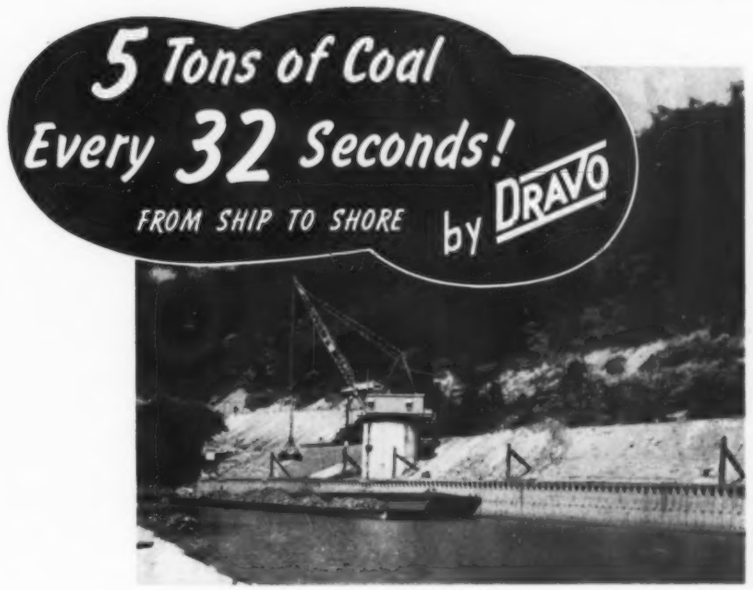
▲ Crouse-Hinds Company has issued several new catalogue sheets for insertion in their Condulet Catalogue 2500. Also included with these new sheets is a checking list for the convenience of catalogue users. These lists enable the user to keep his personal catalogue up to date. For further information concerning this type of catalogue and the insertion sheets please contact the Crouse-Hinds Company, Syracuse, New York.

▲ Bailey Meter Company has issued a bulletin describing a new product which warns boiler operators of possible furnace explosion that may result from loss of ignition. This booklet points out that the best assurance against an explosion hazard resulting from the loss of ignition is for operators to be fully acquainted with furnace conditions and for them to know that ignition is satisfactory.

Write to the Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, Ohio, requesting Bulletin No. 210.

▲ Robins Conveying Belt Company has issued a new bulletin describing the complete line of their manufacture. This publication, which is known as Bulletin No. 109, may be had by writing to the Robins Conveying Belt Company, 15 Park Row, New York.

▲ Linde Air Products Company, a unit of Union Carbide and Carbon Corporation, has issued a new booklet describing the recently perfected wrinkle-bending method for bending pipe. This process is finding wide application wherever pipe must be "tailored" to fit. It depends upon the use of the oxy-acetylene flame for heating a narrow band about halfway around the pipe at the point at which a change of direction is desired. When this band has reached a red heat the pipe is bent mechanically, with the heated portion at the inside of the bend. This causes a slight upsetting of the heated metal and produces a change of direction of from four to six degrees. Copies of this booklet, which gives more detailed information, are available at your nearest district office of the Linde Air Products Company.



THE Pittsburgh Coal Company's Smith Ferry Dock has ample barge accommodations to insure uninterrupted operation. A Dravo whirler mounted on the shore swings a five ton bucket from ship to shore and back to ship again in 32 seconds, which is moving coal in a hurry, as any dockman will say. A fast, simple, effective rig, it enables the Pittsburgh Coal Company's Smith Ferry Dock to enjoy an unusually low handling cost per ton.

Whether the problem is one of modernizing old equipment, replacing obsolete handling machines or designing special facilities to meet new problems, consultation with Dravo may prove to be of great value to you. Added to its ability to fabricate and erect structures such as shown here, Dravo Corporation has had years of experience building docks, retaining walls, plant foundations—everything that enters into the problems of terminal facilities. Bulletin 403 describes docks, mill foundations and terminal equipment. Bulletin 202 describes revolving cranes. Either will be sent upon request. Inquiries relative to specific problems may be addressed to

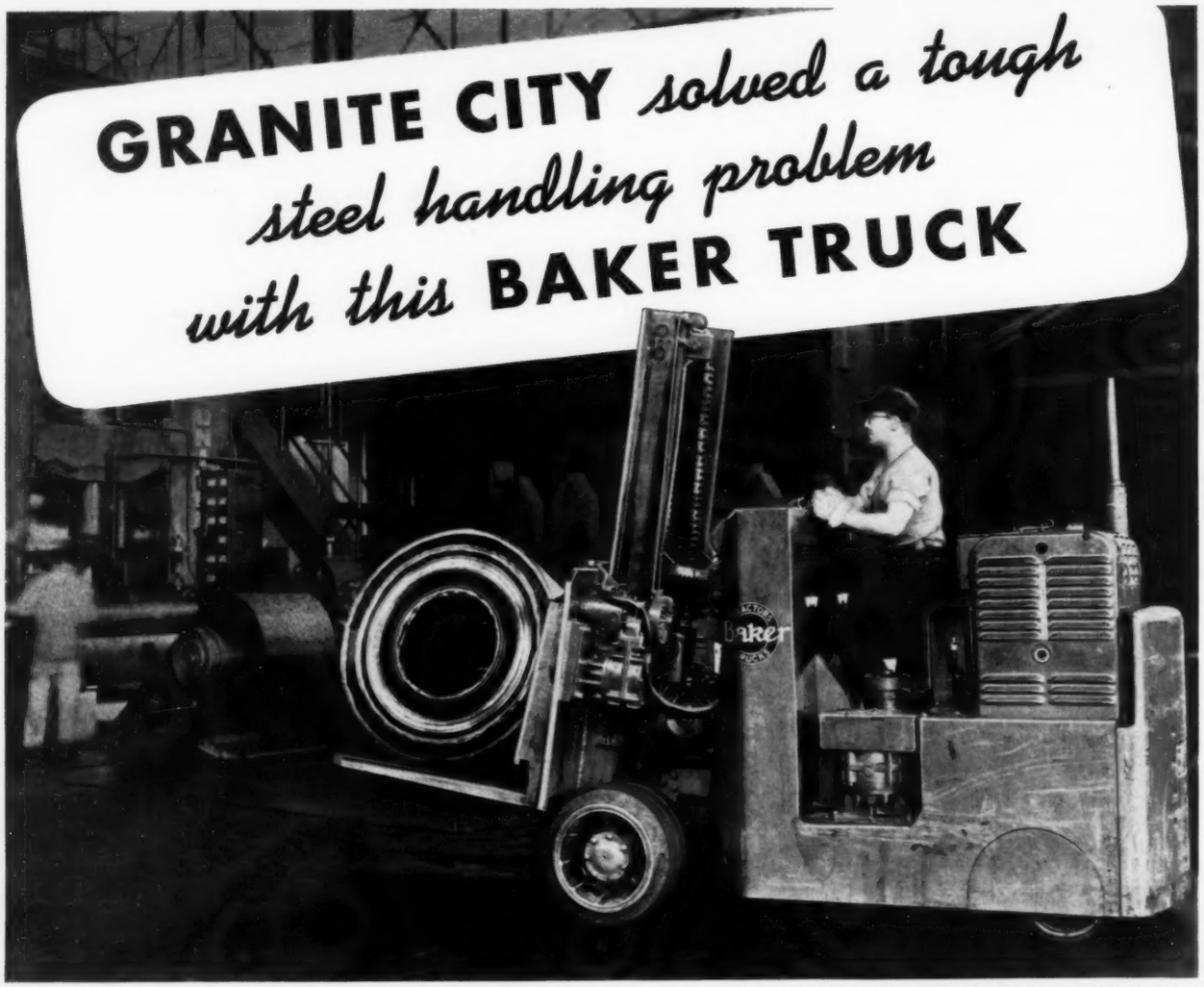
DRAVO CORPORATION

ENGINEERING WORKS DIVISION

SHIPYARDS: PITTSBURGH, PA.—WILMINGTON, DEL.

GENERAL OFFICES AND SHOPS: NEVILLE ISLAND—PITTSBURGH, PA.

GRANITE CITY *solved a tough steel handling problem with this* BAKER TRUCK



Time means Money. Baker Trucks are saving both for GRANITE CITY STEEL with a truck that picks up 6-ton coils of strip and up-ends them in transit. This is just one example of the savings being made in thousands of plants of all kinds. Write today and let the Baker Material Handling Engineer show *you* how great *your* savings can be.

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ITEMS OF INTEREST

Harvey King has been appointed district manager for the Clark Controller Company's branch office in Birmingham, Alabama. Mr. King has had many years' experience in various phases of the electrical industry, and for the past eleven years has specialized in control application. He was formerly connected with the Westinghouse Electric and Manufacturing Company and the Electric Controller and Manufacturing Company. Prior to these connections he was employed in the steel industry, and in distribution work for the light and power industry.

Mr. King's territory will cover Alabama, Tennessee, and the northern portion of Mississippi.

R. L. Harter has been appointed chief engineer of the Trabon Engineering Corporation, Cleveland, Ohio. Mr. Harter, a graduate from the United States Naval Academy, recently resigned from his position as industrial engineer for the Alemite Division, Stewart Warner Corporation. His entire business career has been devoted to the industrial field, and he has specialized in the development of lubricating equipment.

C. N. Johns, vice-president of American Chain and Cable Company, Inc., has been placed in charge of operations assuming the duties of C. G. Williams, who has resigned. Mr. Johns, a graduate of the University of Missouri, has had many years of experience in the steel industry, particularly in the manufacture of wire and wire specialties. In 1913, he joined the Page Steel and Wire Company, now a division of American Chain and Cable Company, Inc., as an employee in the operating department at Monessen, Pennsylvania. After serving as assistant manager, he was made manager of the plant and then was appointed general manager of the Page Steel and Wire Division, which post he has held for several years. As vice-president in charge of operations he will supervise the manufacturing activities of the company's fourteen plants.

Edward I. Pfaff has been appointed sales manager of the Trabon Engineering Corporation, Cleveland, Ohio. Mr. Pfaff was formerly affiliated with the Alemite Division, Stewart Warner Corporation, as a special industrial representative.

H. B. Gay, general sales manager and a vice-president of the Electric Storage Battery Company, Philadelphia, Pennsylvania, has retired from active service after 38 years in the employ of that company.

Frank T. Kalas, general sales manager of Electric Storage Battery Company, Philadelphia, Pennsylvania, has been elected a vice-president of that company. Mr. Kalas, who has had a long and varied experience in all fields of storage battery application, will direct the sales activities of the company as vice-president and general sales manager.

H. L. Coe, formerly located at the Mingo Junction Works of the Carnegie-Illinois Steel Corporation, has been appointed assistant superintendent of the electrical department at the Clairton Works of the Carnegie-Illinois Steel Corporation.

D. C. Peterson has been appointed plant manager in charge of all manufacturing operations for the Buda Company, Harvey, Illinois. Mr. Peterson had been affiliated with the Continental Can Company for the past seven years. Prior to his connection with the Continental Can he served in a technical advisory capacity studying all types of tin plate operations.

Mr. Peterson was formerly connected with the Buda Company for a sixteen year period following 1918.

H. P. Ackerman has been given the entire steel industry as his territory to cover for the valve division of the American Car and Foundry Company, New York, New York. This industry will be now handled by Mr. Ackerman through the New York office.

W. T. Brownscombe has been elected president of the Follansbee Brothers Company, Pittsburgh, Pennsylvania. Mr. Brownscombe, born in Wales 52 years ago, was educated in the United States where he was graduated from Purdue University with a bachelor of science degree in mechanical engineering. He was employed by the American Sheet and Tin Plate Company in the Pittsburgh office for four and a half years, and for two and a half years as master mechanic at Gary, Indiana. Following this, he became assistant superintendent of the tin mill department at Jones and Laughlin Steel Corporation. He left there to become general superintendent of the McKeesport Tin Plate Company, where he was employed for 12½ years, with which company he had a broad range of duties including both mill operation and customer contacts.

A. L. Reichert, formerly with the Bourne-Fuller Division of the Republic Steel Corporation, in the electrical department, has recently been appointed electrical engineer for the Atlas Car and Manufacturing Company, Cleveland, Ohio.

W. H. Melaney, sales manager of the National Roll and Foundry Company, Avonmore, Pennsylvania, has retired after 60 years in industrial work. Mr. Melaney

FRANK T. KALAS

began his career as a roll turner at Portsmouth, with the Phoenix Roll Works in 1880 and subsequently was in the employ of the former George A. Hogg Company, of Pittsburgh. He had been with the National Roll and Foundry Company for the past 25 years.

Obituary

Alfred H. "Pop" Swartz, a veteran in the steel plant equipment field and one of the pioneers of the Association of Iron and Steel Engineers, died January 6 at Grand Rapids, Michigan.

A. H. SWARTZ

Born in Wheeling, West Virginia, in 1864, "Pop" began work at an early age in Pittsburgh, later entering the power plant field at the Cleveland Cable Railway in 1892. About 1895 he entered the employ of the Stirling Boiler Company, of Barberton, Ohio, erecting and testing boilers. After erecting the first Stirling boilers to be installed at the Ohio Works of the Carnegie-Illinois Steel Company, Youngstown, Ohio, he remained there in charge of the steam department. From 1902 to 1909 he was connected with several companies including the Republic Iron and Steel Company, in the steam and power field. Going with the Westinghouse Electric and Manufacturing Company in 1909, he remained with that company for 25 years until retirement five years ago. During the latter part of this period he was special representative for that company in the steel industry.

During his very active business career, "Pop" was a tireless worker in Association activities, giving his efforts unsparingly to its advancement. "Pop" Swartz's passing will be mourned by his many friends in the Association and in the industry.

Ambrose N. Diehl, former president of the Columbia Steel Company, San Francisco, California, died on January 3. Mr. Diehl was born in 1876 in York, Pennsylvania, receiving his education in the public schools at York, and his bachelor of science degree from Pennsylvania State College in 1898, where he specialized in chemistry.

In 1899 he was employed in the laboratory of the Carnegie Steel Company. Six months later he was made assistant blast furnace superintendent, and in 1901 was appointed blast furnace superintendent, which position he occupied until 1915. In that year he became assistant general superintendent of Duquesne steel works and blast furnace. He was elected to the assistant operating vice-presidency in April 1917, and in November of that year he became general superintendent of Duquesne Works. In 1925 he became vice-president and director of the Carnegie Steel Company.

In 1930 he was elected vice-president of the United States Steel Corporation, and in 1932 became president of the Columbia Steel Company.

A. N. DIEHL

Charles A. Fisher, 64, former president of Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania, died January 5. Mr. Fisher retired from active service in January, 1928.

Bracken A. Todd, 46, superintendent of the rolling and blooming mills of the Andrews Steel Company, Newport, Kentucky, died recently. Mr. Todd was formerly associated with the Pittsburgh Steel Company in Pittsburgh.

James A. Morton, formerly steam and fuel engineer, American Steel and Wire Company, Cleveland, Ohio, died recently. Mr. Morton was born in Pittsburgh in 1886, and educated at the University of Pittsburgh and Cornell University, receiving his degree in mechanical engineering at the latter school in 1909. After graduating, he served two years with the American Steel and Wire Company in Pittsburgh as assistant district engineer, supervising installation and testing of power equipment.

From 1911 until 1914, he was assistant mechanical engineer with that company, in charge of tests on heating and annealing furnaces. In 1914, he assumed direction of testing and operation of furnace and power equipment and auxiliaries. He was transferred to Cleveland in 1925, as assistant mechanical engineer, and in 1936 was appointed steam and fuel engineer, which position he held until his death.

Mr. Morton was an active member of the Association of Iron and Steel Engineers.

JAMES A. MORTON